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COMPETITION IN THE REPROCUREMENT PROCESS

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PREFACE

This Memorandum is part of RAND's continuing program of procurement research. It deals with the problem of obtaining competition in the reprocurement of weapon system components, accessories, support equipment, and other technical hard goods.

Under present policies, packages of technical data are often disseminated among firms that were not engaged in earlier R&D and production efforts. The study first examines these reprocurement data policies and their impact on competition. It also explores interfirm commercial transfers of production technology and contrasts the transfer techniques used by the Government with those employed by the aerospace industry. As a method of providing improved access to production technology, and thereby increasing competition, it considers the use of directed licensing and the application of commercial transfer techniques to supplement present procurement policies.

This study should be of interest to public officials concerned with procurement policy, and to various groups concerned with the problems of obtaining competition in purchases of specialized military hard goods.

J. W. McKie is a consultant to The Rand Corporation.

SUMMARY

An unregulated market economy depends on competition as its primary guarantor of adequate economic performance. The history of economic policy in the United States demonstrates continuing efforts to strengthen and preserve market competition and to limit monopoly. These efforts are reflected in antitrust laws, procurement statutes and regulations, and in a variety of other public laws and policies. Apart from its general social merits, competition is also believed to yield lower prices to the purchaser. There is persuasive evidence that this is true for military procurement.

Competition in defense procurement must be evaluated in terms of specific types of goods and services. Although each item the Department of Defense purchases has different competitive potentials and problems, it is useful to think of three general classes of military hard goods. At one extreme lie weapon systems and the initial provisioning of spare parts. Here the barriers to competition are huge. The Government has paid for most of the underlying R&D, the design of production articles is unstable as a result of numerous engineering changes, and the R&D process generally spills over into production activities.

At the other extreme lie off-the-shelf commercial items procured for defense, and items with close civilian counterparts. These items are characterized by privately funded R&D, stability of design, and low start-up costs for Government orders. Here there are few barriers to competition and the DOD has been generally successful in obtaining competition.

This study is concerned with the products that fall in the vast middle ground between these two extremes; that is, the reprocurement of weapon system components, support equipment, and other specialized items. The Government has paid for most of the underlying R&D, designs are fairly stable by the time reprocurement occurs, and there is a well-established production technology. The problem of getting competition in these cases is essentially the problem of providing access to existing manufacturing technology.

Under present policies dealing with technical data, design information is often disseminated among prospective suppliers when the time

comes for reprocurement. The Air Force has an elaborate program for acquiring, screening, and disseminating drawings and specifications. While the current amount of competitive reprocurement that occurs as a result of data dissemination is small relative to the total reprocurement of items, it does account for a sizeable fraction (20 percent in our sample) of all reprocurements that are competitive. Improvement in the quality of data packages acquired under new data policies should permit some enlargement of this fraction as time goes on.

Using commercial licensing techniques, U.S. aerospace firms have had vast experience in transferring production technology to firms that were not engaged in the original R&D efforts. In addition to engineering drawings and specifications -- the principal instruments of transfer used by the Government in the dissemination of reprocurement data -- commercial programs ordinarily call for the transfer of tool design information or actual tooling, production layout and process information, and engineering or technical assistance. These added elements in commercial transfers are generally considered essential in order to give the licensee proper access to the production technology.

Any substantial increase in competition in the reprocurement of weapon system components, accessories, support equipment and other specialized items will require improved access to the developer's technology by other prospective suppliers. It is particularly important to provide more complete information about production techniques and processes that reflect the developer's accumulated learning. The adaptation of commercial licensing techniques to defense procurement under a policy of directed licensing is a promising way to improve access to technology.

As an instrument of defense procurement policy, directed licensing would be limited to situations in which the original producers were unable or unwilling to compete successfully for follow-on production contracts. Because a firm involved in R&D and early production possesses pricing and other advantages over other prospective suppliers, interfirm transfers of technology under directed licensing are unlikely in most situations. For the Government to obtain some of the benefits of competition, however, it would be unimportant whether production responsibility were actually transferred; the benefits would derive from

the developer's awareness of the threat of competition for follow-on production contracts.

In addition to competitive benefits, directed licensing using commercial transfer techniques offers other advantages. First, it would help reduce Government involvement with contractors, not only as a result of increased competition but also by reducing the Government's role as an intermediary in the transfer process. Technology transfer would be largely an interfirm matter governed by commercial practice and the law of contracts. It would also lessen or avoid many disputes over data rights -- the proprietary issues. Finally, some of the data-management and transfer costs of present data policies would be avoided, while others would not be incurred unless the buyer were able to realize savings from the transfer that were over and above the transfer costs.

ACKNOWLEDGMENTS

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I. INTRODUCTION

An unregulated market economy depends on competition as its primary guarantor of adequate economic performance. The history of economic policy in the United States demonstrates continuing efforts to strengthen and preserve market competition and to limit monopoly. These efforts are reflected in antitrust laws, procurement statutes and regulations, and in a variety of other public laws and policies. Apart from its general social merits, competition is also believed to yield lower prices to the purchaser. There is persuasive evidence that this is true for military procurement.

In this connection the GAO exhibits presented at many Congressional hearings are relevant. They show savings on the order of 25 percent or more when an item is bought competitively after a previous sole-source procurement. Based on GAO evidence and on studies conducted within the Department of Defense, Secretary McNamara has used the 25-percent estimate for determining savings in shifts to competition when reporting to Congress on his Cost Reduction Program.*

Various difficulties arise when the Government tries to obtain the benefits of competition in defense procurement. The success of the Government in creating, maintaining, or utilizing competition in defense supply markets has been variable. When it buys civilian goods and services or simple modifications of them, such as blankets, barracks, shoes, and paint, it can buy under competitive conditions; the only peculiar element in such transactions is the sheer size of Government requirements. But when Government tries to secure the benefits of competition for weapon systems and other military supplies designed specifically for

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*Secretary McNamara's 1965 report goes into this subject in some detail. See U.S. Congress, Joint Economic Committee, Subcommittee on Federal Procurement and Regulation, Hearings on Economic Impact of Federal Procurement, 89th Cong., 1st Sess., U.S. Government Printing Office, Washington, D.C., 1965, pp. 12-14. Some relevant GAO reports are contained in U.S. Congress, Joint Economic Committee, Subcommittee on Federal Procurement and Regulation, Background Material on Economic Impact of Federal Procurement - 1966, 89th Cong., 2d Sess., U.S. Government Printing Office, Washington, D.C., 1966.

the defense mission, substantial barriers to competition are encountered. The more nearly unique an item is -- the more specialized, the more technologically advanced, the more innovative, the less fungible -- the less it resembles the competitive commodities of economic theory. Unfortunately, a sizeable and growing fraction of all procurements by the defense establishment, including the vast majority of Air Force purchases, have these characteristics in advanced degree.

This study deals with one method of overcoming some of these barries to competition in defense procurement. This method is the transfer of technology to firms not engaged in the original R&D and production efforts. For purchases of weapon systems and other sophisticated military items, as well as follow-on purchases of weapon systems components, accessories, support equipment and other specialized "hard goods," the firm that performs the original R&D work usually becomes locked in to the program. That is, the firm becomes the only feasible source of supply for all stages of the program subsequent to the R&D phase. This lock-in is compounded by the Government's desire to unify and integrate programs by using the same prime contractor throughout all stages. Unless the entry barriers posed by high design and start-up costs can be lowered, firms chosen at the outset find themselves with monopoly power at later stages. If the Government is to obtain source-of-supply options at later stages, i.e., during the reprocurement process, it may be necessary to provide technical information concerning production to new prospective suppliers.

Competition in defense procurement must be evaluated in terms of specific types of goods and services. Although each item the Department of Defense purchases has different competitive potentials and problems, it is useful to think of three general classes of military hard goods. At one extreme lie weapon systems and the initial provisioning of spare parts. Here the barriers to competition are huge. The Government has paid for most of the underlying R&D, the design of production articles is unstable as a result of numerous engineering changes, and the R&D process generally spills over into production activities.

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The differential role of price competition among various types of goods and services is easily illustrated by procurement statistics. Table 1 divides Air Force procurement in fiscal year 1966 by type of product and method of selecting the contractor. Nearly 50 percent of the total expenditures for "other goods and services" (roughly, the non-specialized items) involved price competition. In contrast, less than 10 percent of the R&D services, and only 2.6 percent of the complete weapon system expenditures, involved price competition. The corresponding figure for "other hard goods" is about 30 percent. The class "other hard goods" deals primarily with the reprocurement process; i.e., the procurement of weapon system components, accessories, and support equipment following weapon system procurement and the initial provisioning of replacement parts. The question of how to obtain more price competition in the reprocurement of specialized military hard goods is clearly an important issue in defense procurement, such goods accounting for expenditures roughly equal to those for complete weapon systems.

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*Of course, procurement difficulties are also encountered in purchasing nonspecialized items. Generally speaking, however, considerable price competition has been obtained for the less specialized goods and services and the DOD, the General Accounting Office and the Congress have been effective in identifying and resolving the problems within the framework of the present procurement system.

Table 1

AIR FORCE PROCUREMENT, FISCAL YEAR 1966

(In $ billion and %)

Contractor Selection Method	Research and Development		Procurement of Hard Goods: Complete Weapon Systems[a]		Procurement of Hard Goods: Other Hard Goods		Other Goods and Services		Total	
	$	%	$	%	$	%	$	%	$	%
Price competition	0.24	9.3	0.05	2.6	0.77	29.7	0.85	48.9	1.91	21.7
Design or technical competition	0.67	25.9	--	--	0.03	1.2	0.09	5.2	0.79	9.0
Single source after price competition	0.03	1.2	0.32	16.9	0.10	3.9	0.04	2.3	0.49	5.6
Other	1.65	63.7	1.52	80.4	1.69	65.3	0.76	43.7	5.62	63.8
Total	2.59	100.0	1.89	100.0	2.59	100.0	1.74	100.0	8.81	100.0

NOTE: Compiled from data submitted on DD Form 350, "Individual Procurement Action Report." Only procurement actions for $10,000 or more with business firms in the United States are included. Detail does not always add to total because of rounding.

[a] Includes complete aircraft, helicopters, missiles, spacecraft, complete aircraft engines, and major engine components.

This study will focus on the problem of obtaining competition during the reprocurement stage, i.e., during follow-on procurement when the design of an item is reasonably stable and the necessary manufacturing technology has been developed. The problem of obtaining competition in the initial procurement of complete weapon systems is much more difficult and inextricably linked to the strategy used in acquiring the underlying R&D. The reprocurement stage may or may not represent the earliest time at which competition can be introduced. Nonetheless, reprocurement is an important and separable stage in the process and techniques which permit "breakout" at the reprocurement stage may have some applicability in the procurement of complete weapon systems.

To sum up, rivalry among firms for defense business does not automatically lead to the availability of substitute products in the area

of specialized hard goods. Military requirements are often unique or so specialized that close substitutes are not sold in commercial markets. Since design and start-up costs tend to be large in relation to the value of production orders, the Government is usually faced with the necessity of paying for the underlying R&D. The result is that the winner of a development contract enjoys some advantages of monopoly during the subsequent phases of a program -- advantages that generally extend into the reprocurement process.*

There are three major barriers that often hamper the entry of new firms into the production of specialized parts, components, or similar hard goods. One is an economic barrier created by high start-up costs. These costs are often so high that new potential manufacturers are uninterested in competing for some specific contract. The second barrier is legal. It results from the possession by the original developer of patents or proprietary rights to technical information.** The third barrier is technological and relates to the difficulty that competitive suppliers may have in producing exactly what is wanted, and to the difficulty of communicating to them technical data good enough to support competitive production. Without such technological rights and information, new firms may be unable to produce at an attractive cost, if at all.

The Government has attempted to overcome these barriers in several ways. To attack the start-up cost barrier, the DOD has been using a technique called multi-year procurement. In essence, it lets long-term requirement contracts that serve to assure the winner of a source-selection competition that he will have a large volume of business over which to spread costs of entry. This approach has had salutary effects, but its application is limited by the inherent uncertainty of forecasting future

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*Note that the term monopoly as used here is different from the customary use of the term. Here it arises from an extreme form of product differentiation that applies to individual aerospace products during the period of their procurement by the military establishment. It is a monopoly only in the sense that, correctly or incorrectly, procurement officials perceive there to be only one feasible source of supply for the item.

**For a general discussion of the problem of data rights and its policy background, see J. W. McKie, Proprietary Rights and Competition in Procurement, The RAND Corporation, RM-5038-PR, June 1966.

military purchase quantities. It also does not deal with the legal and technological barriers to entry.

There are two main techniques now in use to overcome these latter barriers. One is the establishment of standard military specifications for products or the procurement to performance or form-fit-and-function specifications rather than specific configuration or design specifications. Most competition in reprocurement is now obtained in this way. There are inherent limitations, however, on the use of this technique. One limitation is that it can result in the military having to stock a number of items that meet the same form-fit-and-function specifications but which have different physical characteristics and, therefore, require different replacement parts and maintenance procedures. Logistics costs can easily exceed the competitive benefits. Another limitation is that the establishment of standard military specifications is only practical with items having high and recurring demand and well-established physical attributes. In other words, for highly specialized or differentiated items, establishing general specifications can be infeasible or very expensive.

A second approach, which the Government has emphasized in recent years, is to try to develop competition for articles of identical design by acquiring the developer's technical data and then furnishing it to prospective suppliers when the Government decides to reprocure the item. The information or technical data is collected in a "data package" consisting chiefly or entirely of engineering drawings and associated specifications. The Government has struggled to secure data adequate for this purpose with varying success. This policy and its results are the subject of the following two sections.

Later sections examine a possible third approach. It would call for the directed licensing of production technology and the application of transfer techniques used commercially.

II. THE EVOLUTION OF DATA POLICY

The DOD program of data acquisition and transfer had grown to large proportions by the end of the 1950's. From then until the major revisions of data policy of 1964-65, it put into most of its research and development contracts a very broad requirement for all data resulting from performance of the contract. Its overriding policy was to obtain by this requirement all the drawings needed for any possible mission, including competitive reprocurement, even though much of the data was never used for that purpose.

There were certain exceptions to the policy of general acquisition of drawings on R&D contracts. The exceptions are important since they illustrate some of the drawbacks of that policy. One related to "standard commercial items" furnished under the contract; for these the contractor had only to identify sources and characteristics. Unfortunately, source and performance specifications were not enough to support competition when the contractor used designs requiring "standard items" that were available from only one source. This, however, was a minor problem compared to the second exception: proprietary data. Contractors could withhold "proprietary" information, and often did so even when the Government did not regard the data as proprietary. As a result, the Government received a large number of data packages that were incomplete, often containing "Swiss-cheese" drawings from which the contractor had deleted essential information that he regarded as proprietary, and which were unusable for any purpose. A third, de facto exception related to items and services supplied by subcontractors. Data clauses usually provided for delivery of data by these "vendors," but in practice the Government could not always obtain it since the prime contractor was often unable to enforce the obligation on vendors who refused to turn over data to the prime. Vendors frequently claimed that the data were proprietary, whether or not they actually qualified as proprietary under the Government's definition.

As a result of the plenary data requirement, the Government accumulated enormous quantities of drawings and other forms of technical

data.* Owing partly to the exceptions and deficiencies in the data packages that were delivered and partly to the sheer bulk of deliveries, the Government could not exercise satisfactory quality control over the data it received nor ensure that the data would be adequate for missions it was destined to perform. The problems of economy in data management, information retrieval, and quality control began to press for solution.

In 1963-64 the Government undertook a reconstruction of its data policies on all fronts. The new approach proceeded to some extent by trial and error, and the final solutions have not all been reached; nevtheless, its several aspects seem to form a consistent whole.

1. Revised rules for determining rights in data. The policy established a new set of rules governing the rights to the data which the Government procured. The Government would acquire all data, except that pertaining to items developed at private expense, with unlimited rights to use the data for reprocurement or any other purpose, if it decided to order it. Technical data pertaining to items developed at private expense, including data relating to standard commercial items, would be acquired with limited rights, i.e., not for reprocurement from other sources. Thus a private expense test was substituted for the trade-secret test that the Government had formerly used in deciding the validity of proprietary claims in data by private contractors.** In addition, vendors were subject to the same rules on rights in data and could deliver "limited rights" data directly to the Government without disclosing it to prime contractors. The new policy did not solve all problems relating to proprietary data, but those who framed the new regulation hoped that it would eliminate most of the disputes over data rights and end the practice of withholding data. It appears to have sharply reduced both.

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*By 1965, for example, the Air Force alone had over 5 million drawings in its Wright-Patterson Base Depository.

**Under the old policy contractors did in fact withhold much data which they regarded as proprietary but which would not have qualified under a trade-secret test; the so-called "fail-safe clause" in the then-applicable version of ASPR-9 permitted them to do this. The result was the "Swiss-cheese" drawings referred to above. For a fuller discussion see McKie, op. cit.

2. Predetermination of rights. When this procedure was used, the contractor during the negotiation of the contract would enumerate individual data items to be furnished with limited rights.* This gave the contracting parties the opportunity to settle data claims while competition for the contract was still effective, rather than after this fact. This policy was expected to lead to a sharp improvement in the quality of data delivered, and elimination of withholding of data from drawings.

3. Selective ordering of data. A major objective of the new policy was to take all restrictions on or requirements for obtaining data out of the procurement regulations. At the same time, instructions were issued emphasizing that data should be ordered only when a need could be established. This change in policy gave the procuring agencies complete freedom to buy the data they needed and not to buy data when there was no need or when the cost of the data exceeded the value that could be derived from it. This made it possible for the military services to begin to exercise management judgment in the procurement of data.

4. Improvement of data standards and of the process of review and quality control. The Department of Defense in 1964 set up an Office of Technical Data and Standardization Policy and charged it with responsibility for setting overall data policy guide lines for the military services and with data management analysis. The Department also issued a number of new directives and revised others to prescribe better standards for data. The most important of these was MIL-D-1000 (March 1, 1965) which was a long step toward the final standards for workable data policy which the DOD and its Technical Data Office were hoping to achieve. The preamble of MIL-D-1000 was significant:

> 1.1 Scope. This specification prescribes general requirements for the preparation of engineering drawings and associated lists, and for application of Intended Use Categories for their acquisition. This specification reflects Department of Defense policy to buy only those engineering drawings that are needed and to encourage procurement of commercial drawings when they are adequate for the purpose.

The document then proceeded to list 10 Intended Use Categories and the data required to support each. For example:

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*ASPR 9-202.2 (b), April 1965.

3.2.5 Category E - procurement (identical items). Engineering drawings in this category shall provide the necessary design, engineering, manufacturing, and quality support information directly or by reference to enable the procurement, without additional design effort or recourse to the original design activity, of an item that duplicates the physical and performance characteristics of the original design. These drawings shall not provide manufacturing process information unless this information is essential to accomplish manufacture of an identical item by other than the original source.

3.2.5.1 Engineering drawings in this Category [E] shall include, as applicable, but shall not necessarily be limited to: details of unique processes essential to design and manufacture; details of performance ratings; dimensional and tolerance data; critical manufacturing assembly sequences; toleranced input and output parameters; schematics, mechanical and electrical connections; details of material identification; inspection, test, and evaluation requirements and criteria; necessary calibration information; and quality control data.

MIL-D-1000 made it clear that different missions require different kinds of data. On the one hand, if the Government needed only maintenance or cataloguing information, it did not need to load its files with complete manufacturing data that it would never use and which contractors were reluctant to give up, as often happened under the older policy of plenary data acquisition. On the other hand, if the Government did intend to use the data to develop competitive sources of manufacture and if it did own all rights in the data, the document stated in considerable detail what the manufacturer was obliged to furnish. The standards for engineering drawings contained in the technical regulations of the Services set forth the concrete specifications under these data categories.

5. Deferred ordering or delivery of data. As part of the new data management program, the Air Force in 1964 instituted a plan of deferred ordering of data which it has tried experimentally in a few programs. (It is called "SEED," for Supply of Essential Engineering Data.) Its purpose was not only to reduce unnecessary purchases of data but to improve the quality of the data acquired. For systems under SEED, the

contractor stores all the data and keeps it current as design changes. The Air Force orders it out when needed. The advantages of this method of acquiring data are obvious. The Government does not accumulate drawings that subsequently become obsolete, and can obtain a data package at any time describing the then-current model of the item.* It does not have to pay the cost of reproducing data it does not need.** It can order data for missions when it knows what missions it is to perform and the kind of data it must have to perform them.

The disadvantages are not so obvious, but they exist. The principal one is that the Government is not in actual possession of complete information on the weapons system and may not be capable of making the best decisions on design alterations, maintenance and procurement without it. The Government must rely heavily on the cooperation of the contractor, just as it must on contractor coding under AFR 57-6, though it has some checks and controls in both programs.

Another disadvantage is that the contractor's obligation to furnish data on Government request may become difficult to enforce after he has delivered the hardware and been paid for it, and lapses altogether after a specified period following contract termination. The deferred-ordering clause recently incorporated into ASPR applies for only two years after

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*Typically, design changes are frequent especially in the early life of the weapon system. For example, the C-141 transport aircraft had generated 22,500 drawings by the time 5 planes were off the production line in June 1964. By March 1966, there had been 21,516 revisions in these drawings; 8281 items had been added and 1448 had been deleted. In early 1966, revisions were running some 2000 per month. Since the C-141 was a SEED system, these changes did not require changes in the Government's data files.

**The Air Force reports massive savings for the C-141. "Under the old concept of data management, the Air Force would have spent approximately $724,000 for a complete set of drawings on the test contract, plus an estimated $343,000 for update on the production contract. The new concept permitted the Air Force to recoup $211,000 on the original quantity of the test contract, plus the cost avoidance on the production contract . . . [at the end of 10 months] the Air Force had paid Lockheed only $4,579 for data services . . ." Hq AFLC, "Supply of Essential Engineering Data," July 8, 1965, p. 7.

completion of the contract.* However, reprocurements may take place for many years after completion of the contract and delivery of the system. If the Government has not qualified additional sources in the meantime and lacks a data package of its own, it may have no choice but to return to the original manufacturer.

6. Coding and screening of parts for competitive procurement. In the coding of parts for later procurement, the Government invites the prime contractor to indicate what parts can be broken out for competitive procurement, what parts must be procured sole-source from the prime contractor, and what parts must be procured from designated vendors and subcontractors. Government personnel then review these codes, changing them if changes seem appropriate, and assign the final codes for procurement method.**

Participation of contractors in the screening decisions has apparently not resulted in any sharp increase in sole-source procurement, though the system has not been operating long enough to account for a large proportion of reprocurements. On test-screening a sample of 500 parts for the C-130 transport aircraft to see how the system was likely to work, the results shown in Table 2 were obtained.

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*Ralph C. Nash and Jesse Lasken, "Procurement of Technical Data," in Patents and Technical Data, Government Contracts Monograph No. 10, George Washington University, 1967, p. 117. The authors add, " . . . it is clear that there may be enforcement problems after the contractor is paid for the major work on the contract -- the Government has no immediate method of coercing the contractor to perform such a requirement such as is obtained through a withholding clause running to data ordered under the contract." The deferred-ordering clause also provides that the contractor is obliged to furnish data pertaining to an item obtained from a subcontractor for only two years after he accepts the item.

**This element of the present procedure is covered by regulation AFSCM/AFLCM 310-1. It also encourages contractor participation in coding or recoding of parts in "old" systems. Supplement 1 to AFR 57-6 states (4.1.31), "For items already in the inventory, contractor assistance should generally be obtained for any item which has an internal code of 3, 4, or 5 or no code assigned and for which an annual buy value either current or anticipated of $2,500 or over exists." Contractor participation in "high-dollar" breakout coding was originally called the "Competition-With-Confidence Program."

Table 2

TEST SCREENING OF 500 SPARE PARTS FOR THE C-130 AIRCRAFT, BY MODE OF PROCUREMENT

Mode	% of Items	% of Dollar Value
Procurement Before Contractor Participation		
Sole source	69.8	76.2
Selected source	11.8	10.8
Competition	18.4	13.0
Procurement After Contractor Participation		
Sole source	54.8	57.1
Selected source	8.8	17.8
Competition	36.4	25.1

SOURCE: Hq AFLC, Directorate of Procurement and Production.

When a follow-on procurement of a part or component is anticipated, the availability of data and other factors are examined to determine the competitive potential of the item. The data screening process is described in Air Force Regulation 57-6, which the Department of Defense issued under the title, "High Dollar Spare Parts Breakout Program, 1964." It applies to all military procurement of spare parts. Procedures under AFR 57-6 are described in detail in Appendix A. Some results of the screening process are examined in the following section.

III. RESULTS OF DATA SCREENING AND TRANSFER

Data transfer is one of several techniques used by the Air Force to increase competition during the reprocurement process. Under procedures currently in effect the procurement authorities must screen items to be reprocured and decide whether they are suitable for competitive breakout. If the item is not under a deferred-ordering plan, they examine the data in Government possession to see whether it is adequate for manufacture.* Table 3 presents a summary of the screening decisions resulting in competitive and noncompetitive reprocurement made at one of the Air Materiel Areas of the Air Force in a recent year -- Warner-Robins Air Materiel Area (WRAMA). A more complete breakdown of the coding actions for procurement of these items is shown in Appendix A. The figures in these tables do not fully measure the adequacy of data packages for reprocurement, since other reasons for noncompetitive procurement may mask a data problem.** They do show that technical data obtained from original manufacturers had only a small effect on competitive procurement at this AMA. Items reprocured after advertised competition on the basis of complete and adequate technical data packages add up to a relatively small total for WRAMA, and there is no reason to suppose that the proportion would be much greater for the whole reprocurement system. Over one-third (by dollar value) of replenishment spare parts were procured competitively, but the largest single category was parts procured to military specifications, standards, and drawings. This category includes several kinds of data packages. Some are complete packages, including all process information, for items that have been designed and engineered entirely by the Air Force or the other

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*If the item is under a plan of deferred ordering, it is also screened for competitive breakout, at which time the procurement authorities must decide, among other things, whether the data package is likely to be sufficient for competitive sources; but the original manufacturer supplies the specified package only when called for.

**Of course, items can sometimes be procured competitively to performance or form-fit-and-function specifications even when adequate manufacturing data are lacking, although it leads to the introduction into the inventory of items of different designs.

Table 3

A SAMPLE OF AIR FORCE REPROCUREMENT EXPERIENCE
(In $ million)

		Amount
Noncompetitive procurement		
Data inadequate or incomplete	25.1	
Proprietary data	5.9	
Urgent procurement	35.6	
Technical reasons other than data	20.2	
Small dollar amounts (not screened)	21.5	
Other	1.5	
Total noncompetitive		109.8
Competitive procurement		
Data package complete	13.8	
Procurement to military specifications or standards	37.8	
All others	10.8	
Total competitive		62.4
Total, all reasons		172.2

SOURCE: Warner-Robins Air Materiel Area statistical records for FY 1966. Additional details are shown in Appendix A, Table 9.

military services. Some are mixed packages to which the Air Force has contributed the essential design information with the rest drawn from the public domain. Some are substitutes for proprietary data packages and consist largely of performance specifications or form-fit-and-function specifications which the Air Force uses to generate competition when a complete data package is either unavailable or unsuitable for that purpose. The AMAs and other procurement offices obviously must depend heavily on their own engineering expertise when making these decisions.

The competitive category "data package complete" also depends to some extent on the procurement offices' engineering. Many data packages contain manufacturing process information which the original supplier may regard as proprietary and which he does not reveal in full. When an AMA decides to reprocure an item and discovers that some of the manufacturing process information is incomplete and/or claimed to be proprietary, its engineers may try to find in the enormous store of engineering and manufacturing information in the public domain or

published by the Government a standard military specification that is the equivalent of the supplier's specification or is an adequate substitute for it. This is quite common, and such substitutions are very frequent in data packages used in advertised competition.*

In view of the effort and expense that the Government has poured into the data management program, it is a bit dismaying to see that in the WRAMA sample the procurements coded noncompetitive because the data were inadequate or incomplete amounted to a larger dollar total then the procurements coded competitive with data package complete. There were, in addition, other categories, both competitive and noncompetitive, that indicated inadequate data packages. (See Appendix A for details).

The most common cause of inadequacy in a data package that would otherwise be suitable for competitive procurement is simply that one or more drawings are missing from the package. Less commonly, it is the absence of essential information from a drawing, such as tolerances or material specifications. (In the past, contractors occasionally withheld such data deliberately because they regarded it as proprietary, but proprietary restrictions are now more likely to appear in other categories.) If the data package is incomplete, the AMA may decide to complete it by buying the missing information, assuming that the original supplier still has it available, or it may find other ways of obtaining it, such as reverse engineering. The Air Force and the other services have devoted considerable effort in recent years to improving their management of data to insure that data packages when received are complete and properly drawn according to specification.** However, much

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*One of the authors examined over 200 data packages used in competitive reprocurement at two AMAs -- Warner-Robins and San Antonio -- during 1966-1967. In over half of them the AMA engineers have substituted military specifications or "best shop practice" for private specifications.

**Under a deferred-ordering system many of these imperfections in data packages can be eliminated, at least during the period in which the contractor is responsible for producing a complete and current data package on demand. The contractor himself might experience problems in keeping his data complete, current, and fully informative, but the data would no longer pass through Government storage and retrieval, where its quality is often further eroded. The advantages of deferred-ordering in quality control diminish sharply, of course, after the contractor's responsibility expires for updating and guaranteeing data packages.

of the data in possession of the Air Force which has to be used in reprocurement is of an earlier vintage when data control was much looser. Of course, documents also can be lost or defaced even in the best-managed system.

The screening codes do not assure that competing manufacturers will actually be able to use a "complete" data package without experiencing difficulties. The screening decisions have to be tested in practice. To determine whether other manufacturers have actually been able to use the data packages as intended, we must examine their experience with data transfers.

Difficulties with data transfer -- meaning the difficulties that a producer might experience in using a data package which he did not create himself but which has been transferred to him by the Government or at its behest -- can take several forms. Most fundamental is the problem of transferring adequate information on complex designs and processes through the medium of documents. To what extent can manufacturers really use other firms' data, of the type described, to produce interchangeable parts and identical articles?

A firm with its own technologically sophisticated R&D division and a large staff of competent engineers does not ordinarily like to make exact copies of another firm's designs. In nondefense business such a firm would consider copying to be a sign of inferiority. Some of the difficulty experienced with data transfer is undoubtedly due to the insistence of engineers and production people on using their own process and on "improving" the design and engineering of the item.

Another source of difficulty is within the data package itself -- deficiencies or inaccuracies which the screening engineers are unable to detect or evaluate for one reason or another. In the absence of evidence to the contrary, they have to assume that dimensions are correctly shown, that specified processes are the ones actually used in manufacture, etc. If these assumptions are wrong, the difficulties will show up only when a competitive firm actually tries to use the package to manufacture the part. Two of the most troublesome sources of error, for example, are alterations in shop practice which fail to get back to the data package and the closely allied problem of failure

to update the drawings to reflect changes in design.*

The procurement authority screens out replenishment spares whose data package is not adequate for competitive reprocurement and cannot be made adequate at reasonable cost. Clearly, a tight screening policy will help to ensure successful competitive reprocurement of those items that are passed through the screen.

Because there is no post-audit system for use of data in competitive procurement, it is difficult to estimate the extent and incidence of data problems in the thousands of reprocurement contracts executed annually. The authors reviewed a sample of 115 contracts for parts procured competitively during the last three years by two AMAs -- Warner-Robins and San Antonio. The contract files had to be studied in some detail to determine the experience of the contractor in using the data to meet the contract specifications.** In this small sample, 25 contracts went to the original designer after competitive bidding. In the remaining 90 contracts, 5 contractors had definite trouble with data transferred from the original designer, while 3 more contract histories hinted at data problems. In none of these cases, however, did data problems prevent the contractor from ultimately fulfilling his contract obligations. In order to secure a somewhat larger set of illustrations of data problems, procurement officers at SAAMA were then asked to search their files and memories for additional cases in recent years. They located about 20 more significant cases in the competitive procurement category. Selected case summaries are contained in Appendix B. They illustrate the variety of forms in which data problems may turn up in the actual practice of competitive reprocurement of spare parts. Most of these problems involved actual or claimed errors

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*This statement is based on interviews with AMA engineers responsible for reviewing and screening reprocurement data packages.

**Mrs. Gerti Brunner assisted in this review. We also reviewed about 80 histories of noncompetitive procurement for comparison. The sample excluded procurements of small dollar value that were not screened. It was not exactly a random sample of high-dollar parts; it was too light on vendor-supplied items and too heavy on parts for transport aircraft. (All contracts for electronics that were reviewed turned out to be noncompetitive.)

or omissions in the data. Unfortunately, there is no way to judge the extent of the problems that may have arisen because adequate technology was not obtainable solely from engineering drawings and specifications.

Another, admittedly rather remote, test of the technical efficacy of the evaluation process is provided by the "Quality Audit Program" for a sample of spare parts procured by the AMAs. These figures are collected and published by Headquarters Air Force Logistics Command. Table 4 shows the results for Fiscal Years 1964-1966. No significant difference in the percentage of sample items not conforming to contract standards appears between the items procured sole-source and the items procured competitively. Since the sole-source category may contain parts that are more complex and more likely to fail to meet standards than the competitive category, the similarity in rate of nonconformity

Table 4

QUALITY AUDIT OF SPARE PARTS PROCUREMENT

Fiscal Years 1964-1966

Parts	Fiscal Year		
	1964	1965	1966
Parts procured competitively			
Total number audited	4098	4308	4778
Number nonconforming	927	1000	606
Percent nonconforming	22.6%	23.2%	12.7%
Parts procured sole-source			
Total number audited	2313	2683	2551
Number nonconforming	525	502	346
Percent nonconforming	22.7%	18.7%	13.6%
Overall totals			
Total number audited	6411	6991	7329
Number nonconforming	1452	1502	952
Percent nonconforming	22.6%	21.5%	13.0%

SOURCE: Hq AFLC, Quality Audit Program for Spare Parts, September 1966.

may attest to factors other than the effectiveness of the competitive breakout program. It should also be remembered that failure of parts to conform to contract standards may be due to other causes besides data problems.*

Apparently the great majority of competitive procurements go through to completion without any sign of data problems. On the other hand, if this small sample is at all indicative, problems with the data package are not rare and unexpected events. This experience takes place against the background of careful and thorough screening. The screening process removes from the competitive arena those items which in the judgment of the reviewers are technically unsuitable for competition. What is left is an array of spare parts of stable design, requiring fairly well-known processes for manufacture, capable of being mated to other parts made by other suppliers, and involving no pronounced uncertainties of function and performance.

It might be possible to procure other items competitively besides the ones passed through the screen. But the Government probably could not enlarge the sphere of competitive procurement of spare parts and components very much on the basis of the conventional data package. Especially with the more technically complex items, there seem to be some aspects of production know-how and engineering that simply cannot be transferred by means of engineering drawings and specifications. The modest amount of competition obtained through data transfer reflects the importance of complex parts and components in Air Force procurement. Of course, procurement officials recognize the need to supplement drawings and specifications with other information in order to support competitive manufacturing. Indeed, manufacturing support data is defined to include operation sheets and machine instruction sheets; machine-loading control data; treatment data; tools, jigs, and fixture data; product, process, or assembly data; and plant layout, machine tools, and work

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*The reason for the sharp drop in the overall rate of nonconformity from 1965 to 1966 is explained by a change in policy; minor characteristics or attributes of the item were no longer evaluated for conformity after the third quarter of Fiscal Year 1965.

station data.* As a matter of practice, however, data transfer is ordinarily limited to engineering drawings and specifications even though officials are authorized to procure supplemental data and data pertaining to items developed at private expense.

The bargaining problem in the procurement of supplemental data to support competitive manufacturing is simply another form of the general problem of dealing with a firm on a sole-source basis. Data requirements cannot be anticipated at the outset of a program, so the question of price arises at a time when the developer has acquired monopoly power in the sense that he is the only possessor of all of the technology required to produce an item. The firm is in a position to extract monopoly rent regardless of whether the Government buys production articles or simply technology.

The main point here is that drawings and specifications and underlying data rights do not necessarily provide access to technology sufficient to support competitive manufacturing. The Government stands to gain little by procuring supplemental data if it must do so after the developer has acquired monopoly power over the production of the item.

There are two basic issues. One concerns the embodiment of technology, i.e., the nature and form of the knowledge that must flow to a new supplier. The other concerns the techniques used to assure an orderly flow of knowledge. The following section will examine the arrangements and techniques used commercially for the transfer of production technology and will explore their implications for defense procurement policy.

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*As defined in DOD Instruction 5010.12 (Incl. 1).

IV. COMMERCIAL TRANSFERS OF AEROSPACE TECHNOLOGY

Commercial transfers of technology through licensing have grown to huge proportions during the past decade. The magnitude and growth of international licensing by U.S. firms are shown in Table 5. The table does not distinguish between license payments for patent rights and payments under "know-how" licenses. However, most of the increase in royalty payments over the past decade, and a substantial fraction of the royalty payments, appear to have resulted from licenses involving know-how.*

Table 5

INTERNATIONAL RECEIPTS AND PAYMENTS OF ROYALTIES BY U.S. CORPORATIONS, 1957-1966
(In $ million)

Year	Receipts from Foreign Firms			Payments to Foreign Firms		
	Affiliated Firms	Other Firms	Total	Affiliated Firms	Other Firms	Total
1957	238	140	378	26	22	48
1958	246	168	414	26	25	51
1959	348	166	514	24	28	52
1960	403	247	650	27	40	67
1961	463	248	711	34	46	80
1962	580	257	837	57	43	100
1963	660	267	927	61	50	111
1964	756	301	1057	67	60	127
1965	924	301	1225	67	66	133
1966	1045	271	1316	64	73	137
Total	5663	2366	8029	453	453	906

SOURCE: U.S. Department of Commerce, Office of Business Economics.

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*The distinction between patent licensing and know-how licensing is somewhat arbitrary because know-how licenses cover not only the technology but also any underlying patent and proprietary rights. In the case of know-how licensing, technology is viewed as a principal ingredient even though underlying rights to the technology are included. An examination of the content of 1205 foreign licenses of 55 U.S. Corporations showed that know-how was included in 515 cases. The licensing of patents or trademarks accounted for the remainder. For details, see J. N. Behrman and W. E. Schmidt, "New Data on Foreign Licensing," Patent, Trademark, Copyright Journal of Research, Education, Vol. 3, 1969, p. 370.

Know-how licenses typically call for royalty payments of approximately 5 percent of the value of licensed production. While separate data on know-how licenses are not available, probably on the order of $1 billion in royalties was paid to or by U.S. firms under these licenses during 1966 -- payments that resulted in roughly $20 billion worth of licensed production. This amount of licensed production currently exceeds the total procurement of hard goods by the defense establishment.

Of special relevance to this study, U.S. aerospace firms have been particularly active in the field of know-how licensing. Thousands of airframes, aircraft engines, and accessories have been produced by firms not involved in R&D and initial production. Table 6 summarizes data on the international production of aircraft under license.*

The point revealed by Table 6 is simple but impressive. Aerospace firms have accumulated vast experience in the art of transferring technology necessary for the manufacture of sophisticated aerospace equipment. Practically every important aerospace firm in the world has served as licensor or licensee in at least one of these programs. A number of firms have been involved in both capacities -- licensor of technology in some programs, recipient in others. Consequently, it seems reasonable to examine their procedures for transferring technology to find out what is required to enable a firm to manufacture complex items that it did not develop.

Techniques by which production technology is transferred vary from program to program. Even so, some generalizations about the transfer of aerospace production technology are possible. The question is: what is technology, i.e., what actually does move that permits a firm to manufacture technically sophisticated products that have been developed and produced by another firm? In the case of airframes, aircraft engines and other specialized aerospace production, a great deal of information on production techniques and processes is usually provided. In addition to engineering drawings and specifications -- the major instruments of technology transfer in the Government's reprocurement data program -- tool design information (or actual tooling),

*Appendix C lists major aerospace license agreements for the production of aircraft, aircraft engines, and missiles.

Table 6

INTERNATIONAL PRODUCTION OF AIRCRAFT UNDER LICENSE, 1950-1967[a]

(In $ million)

Location of Licensor	Location of Licensee	Bombers	Fighters	Other Military	Helicopters	Civilian Transports	Total
U.S.	Europe	--	(1,393) $2,046	(100) $3	(2,183) $294	--	(3,676) $2,343
U.S.	Other	--	(2,532) $1,002	(568) $241	(570) $94	--	(3,670) $1,337
Europe	U.S.	(403) $484	--	--	--	(278) $148	(681) $632
Europe	Europe	--	(899) $365	(669) $109	--	--	(1,568) $474
Europe	Other	(48) $372	(669) $109	--	(100) $20	(44) $66	(861) $567
Total		(451) $856	(5,493) $3,522	(1,337) $353	(2,853) $408	(322) $214	(10,456) $5,353

NOTE: Numbers of aircraft shown in parentheses.

[a]Individual license agreements underlying these and other programs are listed in Appendix C.

production layout and process information, and technical or engineering assistance, are almost always provided. For example, an earlier study examined the transfer process that enabled Japanese firms to manufacture military aircraft that were developed and initially produced by U.S. firms.* Table 7 contains a list of the items provided by the licensor in each of the four programs. Empirical evidence such as that contained in Table 7 implies that engineering drawings and specifications constitute only a small fraction of the manufacturing know-how supplied by the licensor, even in the area of data alone.**

The results of a recent survey tend to corroborate these findings. Officials of 15 major aerospace firms were questioned about policies and practices relating to transfers of manufacturing know-how under license.*** One question concerned the need for technical assistance in conjunction with licensing. All 12 firms responding affirmed that various forms of engineering or technical assistance were frequently used in conjunction with licensing agreements. When elaboration was offered, there was the consistent view that technical assistance is a fundamental part of a successful program whenever the technology pertains to a complex product.

One authoritative study of licensing sums up the requirements for successful transfers of technology as follows:

> The production know-how and assistance made available under licensing agreements includes information, materials, and services of the following types: (1) specifications, designs, and production techniques; (2) planning and construction of plant facilities; (3) purchase and installation of machinery and equipment; (4) training of license personnel; (5) adaptation of products and production techniques;

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*For a discussion of techniques by which know-how was transferred between U.S. and Japanese firms in various co-production programs, see G. R. Hall and R. E. Johnson, Aircraft Co-Production and Procurement Strategy, The RAND Corporation, R-450-PR, May 1967.

**For example, Appendix D contains an eight-page list of data furnished to Mitsubishi during the F-86F program. Only three pages pertain to engineering data; the remainder lists data on production, inspection, and purchasing.

***This survey was conducted in 1967 under RAND auspices by Ralph C. Nash, Jr., Associate Dean, National Law Center, George Washington University.

Table 7

JAPANESE CO-PRODUCTION OF U.S. MILITARY AIRCRAFT

Program Feature	Type of Aircraft			
	T-33A	P2V-7	F-86F	F-104J
Number of aircraft involved:				
Knockdowns from U.S.	20	6	10	7
Component parts from U.S.	10	8	60	10
Fabricated in Japan	180	28	230	190
Total	210	42	300	207
Items supplied from U.S.:				
Data[a]	limited rights and all data	limited rights and all data	limited rights and all data	limited rights and all data
Technical assistance	59 men	about 60 men	32 men	about 60 men
Tooling	13 key masters from U.S.; about 21,000 built in Japan from U.S. designs	27 key masters and some production tools from U.S.; rest built in Japan from U.S. designs	complete set from U.S.	11 key masters and over 5,000 plaster splashes and Mylar reproductions. Tooling built in Japan from U.S. designs.
Manufacturing support	selected parts, engines, armament	selected parts, engines, armament, some electronics	selected parts, engines, armament	selected parts, some engines, armament, most electronics
Companies involved:				
U.S.	Lockheed	Lockheed	North American	Lockheed
Japanese	Kawasaki	Kawasaki	Mitsubishi	Mitsubishi
Period of production	1955-59	1958-63	1955-61	1961-67

SOURCE: Compiled from data contained in Hall and Johnson, op. cit.

[a]Each license agreement covered all data necessary to support the production program, including proprietary data, shop practices and techniques, and process information. Appendix D is a complete list of the data furnished to Mitsubishi during the F-86F program.

and (6) engineering and consultant services and advice.*

The same study lists the following sample contract provisions for know-how and technical assistance:

> Licensor shall from time to time, and to such extent that it shall consider to be reasonably necessary for the performance of this agreement, furnish to licensee information and specifications as to design, engineering, manufacturing, and other operations, processes, or experience incidental to the manufacture or procurement of such parts or portions of the equipment as may be manufactured or procured by licensee and to the assembly and sale of completed units of the equipment by licensee.
>
> The licensor shall communicate to the licensee upon request such information relating to licensed material as shall from time to time be in current use by the licensor in the manufacture of licensed material and which shall be of use to the licensee in its licensed operations.
>
> Such information shall consist of drawings, blueprints, design sheets, bills of material, material specifications, photographs, photostats and similar data known as engineering, manufacturing and operating information, and at the option of the licensor, designs and specifications relating to manufacturing equipment, tools, dies, jigs, and fixtures, but shall include only such information as is (a) available in the records of the licensor and (b) applicable to the operations of the licensee.
>
> Licensor shall assist, consult and cooperate with licensee personnel in the assembly, design, engineering, manufacturing, inspection, and servicing of the licensed products and components, in the selection of the necessary and proper plant layout, machinery, tools, equipment and production-flow for the economical manufacture of such licensed products and components by licensee.**

There is a striking contrast between what is transferred in commercial organizations with the Government's policies of diffusing manufacturing technology in order to increase competition in procurement. In the latter case, the Government acquires, stores, screens, and finally

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*Foreign Licensing Agreements: II. Contract Negotiation and Administration, Studies in Business Policy No. 91, National Industrial Conference Board, 1959, p. 32.

**Ibid, p. 72.

disseminates packages of technical data to prospective suppliers in the reprocurement of technical hard goods. Generally speaking, a data package contains only engineering drawings and specifications. In other words, the Government's approach to transferring know-how involves the dissemination of a small portion of those things in which know-how is embodied, judging from the views and practices of industry.

This brings into question the extent to which the Government's policies provide adequate access to production technology. Present data policies are reasonably appropriate for increasing competition with items of modest complexity, i.e., where manufacturing know-how is embodied largely in design information. Where highly specialized products are to be reprocured, however, it seems unlikely that present data policies can lower the entry barriers sufficiently to permit competition.

Even though the use of commercial transfer techniques in defense procurement might improve access to technology, a number of issues and problems would need to be resolved if the benefits of competition are to be obtained in this manner. As the extent of the information to be transferred increases, problems of data rights and contractor motivation to transfer become increasingly difficult, and the Government's role as middleman in the transfer process becomes more cumbersome.

As a method of dealing with these problems, the following section explores the possible use of directed licensing in defense procurement. Emphasis is placed on using directed licensing in an environment where the transfer techniques and the roles of the parties reflect standard commercial practice.

V. LICENSING AS AN INSTRUMENT OF PROCUREMENT POLICY

Improved access to aerospace production technology appears to be a prerequisite to any major increase in competition. This section considers a policy innovation that would provide better access to technology and supplement present technical data policies. This innovation involves provision for the licensing of production technology as a precondition of Government R&D contracts, under which the Government could designate a licensee at the reprocurement stage if transfer were deemed desirable. The nature and flow of technology would be patterned after commercial techniques and arrangements to the extent possible.

The purpose here is not to propose the specific details of a policy of directed licensing. Instead, this section will consider how directed licensing and commercial transfer techniques might be incorporated into defense procurement policy and will examine some of the issues and problems that might result.

Adequate protection of the interests of the parties is fundamental to the success of any licensing policy. Consider first the position of the Government. Armed with legal rights to some but not all design information, the Government desires the benefits of competitive reprocurement. The developer possesses the design information, has legal rights to some of it, and also enjoys learning advantages accumulated from prior production experience. If enough of these advantages can be transferred without exorbitant expense, then the Government will be in a position to solicit price quotations from various prospective suppliers and thereby gain some of the benefits found in competitive markets. The Government's problem is to keep the transfer costs low in relation to the competitive benefits. This simply means that any scheme by which the licensee pays the developer for his knowledge will have to be worked out in advance -- before the developer has accumulated design and other advantages that enable him to bargain as a monopolist. In sum, provision must be made in the R&D contract for the eventual licensing of production technology to a firm the Government could designate at a later time. Any lump-sum payments or royalties for the transfer of technology would be predetermined and stipulated in a clause of the R&D contract. Otherwise, monopoly

pricing by the licensor would offset any possible advantage associated with technology transfer.

Another important issue concerns the payment of royalties, although this is more of a practical question than a legal or ethical one. There is some precedent for directed licensing on a royalty-free basis in defense procurement. An omnibus clause containing such features was incorporated into the contract for the Phoenix missile when it was being developed for the Navy version of the TFX. Despite vigorous objections on the grounds the clause was coercive, bidders agreed to accept it.* A recent change to the Armed Services Procurement Regulation recognizes licensing as a valid technique for establishing a second source for a

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*The clause reads: "The Contractor shall furnish to the Government such engineering and other technical assistance in the form of 'know-how', trained personnel, and instruction and guidance of Government personnel or the personnel of third parties, jigs, dies, fixtures, or other manufacturing aids, and such other assistance, information, rights, or licenses, as the Contracting Officer, within a period of three years from final payment . . . may order in writing for the purposes of facilitating or expediting the establishment of sources other than the Contractor or any pertinent subcontractor for the manufacture of the TFX missile system, or of any sub-system, component, or part thereof, or related equipment, or for any other purpose related to the TFX missile system. The Contractor may request, and the Contracting Officer shall make, in accordance with the procedures of the Changes clause of this contract, an adjustment in the estimated cost to compensate the Contractor for the actual cost of furnishing such engineering and other technical assistance to the extent not previously reimbursed by the Government, together with reasonable compensation for any rights or licenses required by the Contracting Officer; provided, however, that no amount shall be included in such adjustments as compensation for the value of any technical information, knowledge, or 'know-how', possessed by the Contractor, or acquired by any pertinent subcontractor in the performance of a subcontract under this contract or any follow-on contract with the Contractor, involving the TFX missile system, whether or not included in any of the Subject Data." Quoted in R. C. Nash and I. Kayton, Patents and Technical Data, Government Contracts Program, George Washington University, Washington, D.C., n.d., p. 45.

The Phoenix Missile data clause was narrowed somewhat in subsequent applications. In the end it appeared in the contracts for only four systems, while the Government cast about for some less peremptory way of achieving its purposes. See the remarks by John L. Howard, "Proceedings of Air Force/Industry Data Management Symposium, September 28, 29, and 30, 1965," p. 105.

privately developed item (ASPR 1-304.2(b)(3)).

Even though royalty-free licensing may be possible, effective transfers of technology seem to require the support and cooperation of the licensor, judging from commercial experience. Payments made under commercial licenses provide the necessary motivation. Of course, no system of licensing directed by the Government can exactly duplicate commercial incentives, and cooperation in response to directed licenses may not be as complete even when the licensor receives royalty payments. At the same time, royalty payments may prove much more effective in stimulating transfer than directed licensing on a royalty-free basis.

A view encountered fairly often among Government officials is that engineering drawings and other data are the property of the Government and, therefore, a Government contractor should not be in a position to experience economic gain by providing this information to another party. This view has a measure of sanctity, but it fails to distinguish between data rights on one hand and access to technology on the other. In fact, the patent or proprietary content of many commercial licenses is quite small. Royalty payments in these cases are made primarily for access to the technology, not for rights. Therefore, there is no ethical reason to discourage interfirm royalty payments even in those situations where the Government has full data rights.

How large should royalty payments be? On one hand, they should be sufficient to motivate the licensor to provide his technology as generously as he does in commercial programs, if that is possible. On the other hand, large royalty payments will dilute the competitive benefits to the DOD. The problem, of course, is to strike a balance between these factors. While only trial and error will reveal the appropriate level, royalties commensurate with commercial practice would seem a reasonable choice as a point of departure.* A payment of this size should prove to be small in relation to competitive benefits and, therefore, should be of no serious concern to the Government.

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*Royalties under commercial licenses of know-how in the aerospace field usually amount to 5 percent of the value of licensed production. The variation about this percentage is small, suggesting that royalties are usually based on a standard pricing convention.

Would a system of directed licensing be fair to developers of military products? The answer seems to be affirmative, given proper conditions for licensing and the proper provisions in license agreements. Consider first the conditions under which a developer might be directed to license his technology. There would be no advantage to the Government in directing a firm to license unless it failed to win a competition for a follow-on production order. Any prospective supplier engaged in the competition would have to pay royalties and any other direct costs of transfer, and would incur some additional costs because of start-up and learning advantages possessed by the developer which could not be completely transferred. In short, the developer would have a significant pricing advantage over his competitors, an advantage that would serve to guarantee his position in the program providing he is a reasonably efficient producer. Not only does directed licensing assure the developer of preferential treatment in pricing, but the payment of a royalty provides him with some compensation for his know-how even when he loses in competition with other firms.

In addition to protecting or compensating the developer in the manner outlined above, some explicit protection of certain trade secrets may also be provided. For example, consider an input developed at private expense and so identified in the original R&D contract under present predetermination-of-rights policies. Since the input would only relate to a small fraction of the items to be produced under license, arrangements might be worked out to permit the licensee simply to purchase the items requiring the proprietary input.*

Especially with the more sophisticated aerospace products, several firms will likely have been involved in the R&D and production in addition to the recipient of the Government R&D contract. It may therefore be necessary to arrange for the transfer of technology between the developer and his affiliated suppliers and the licensee and his affiliates.

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*Because of set-up costs or investment considerations, it has been common practice in co-production for a licensee to purchase back-up manufacturing of selected items from the licensor. Examples of this practice are shown in Table 7.

In other words, it is important to extend the license provisions in the basic R&D contract to other parties that may be involved, such as subcontractors, subs of subs, and so on. There appear to be no legal difficulties in extending the provisions for licensing in the R&D contract to include third parties.

There is also the question of the compatibility of directed licensing in defense procurement with other public policies. In this connection it is noteworthy that compulsory licensing has been a traditional instrument of antitrust policy in various countries. In the United States it ordinarily involves groups of patents and occurs after the patent owner has been found guilty of violating antitrust laws.* While this type of compulsory licensing may increase competition by increasing the number of supply options available to buyers, the primary aim of compulsory licensing in the United States has been to limit the monopoly power derived from controlling a group of patents.**

As a method of limiting monopoly, directed licensing in defense procurement is quite consistent with compulsory licensing as an instrument of antitrust policy. In fact the case for using directed licensing

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*In Western Europe compulsory licenses are often directed on the grounds of nonuse by a patentee. A worthwhile discussion of compulsory licensing is contained in Fredrik Neumeyer, "Compulsory Licensing of Patents Under Some Non-American Systems," Study of the Subcommittee on Patents, Trademarks, and Copyrights of the Committee on the Judiciary, U.S. Senate, 85th Cong., 2d Sess., 1959.

**It is worth noting that voluntary licensing may also serve to increase competition, for example, when the licensee becomes an additional source of supply in an existing market. A brief description of the impact of licensing on competition is provided by L. James Harris and Irving H. Siegel, "Evolving Court Opinion on Patent Licensing: An Interaction of Positive Competition and the Law," Patent, Trademark, Copyright Journal of Research, Education, Vol. V, No. 2, 1961-62, pp. 110-113.

There have been instances in which licensing has had anticompetitive effects. These effects can arise from an industry's use of patent pools in a manner that blocks the entry of new firms. This is not likely to be a problem in the aerospace industry, however, with its emphasis on trade secrets and its rapidly changing technology. Patents are not of great importance for aerospace procurement items and know-how is usually short-lived and often system-specific. Therefore, the ability to block a new entrant from the industry by means of a "technology pool" is low.

in defense procurement is in some ways stronger. The problem in defense procurement is to provide improved access to production technology, much of which came into existence as a result of prior Government contracts. In other words, directed licensing in defense procurement serves to combat monopoly power that has been created as a result of defense procurement. This is quite different from the antitrust situation in which the source of monopoly power is not considered.

The vast majority of commercial licenses, including all of those on which data have been presented, are voluntary. That is, licensor and licensee enter into a voluntary agreement concerning the transfer of technology, information and rights. Generally speaking, firms enter into license agreements in order to increase their participation in certain markets. Of course, firms that possess patents or know-how are not anxious to hand over rights or knowledge to close competitors. For this reason, most aerospace licensing has occurred on the international scene; domestic know-how licenses are few and usually involve products falling outside the major production or marketing activities of the licensor.*

Since directed licensing on the domestic scene would represent a departure from industry practice, it is important to consider what impact involuntary licensing might have on the competitive or technological positions of licensors. First of all, in view of pricing and other advantages of the developer in competitive bidding, it seems unlikely that any significant amount of technology would be transferred by a single given firm. From the Government's standpoint, whether technology were actually transferred is unimportant. What is important is that the developer would know he was competing against rivals for follow-on production orders and competitive pressure would result.

The second point is that the license agreement itself would spell out limitations on the use of know-how by the licensee. In addition to limiting the use of the technology to filling Government orders, nondisclosure provisions are also customary whenever trade secrets are involved.

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*A number of aerospace firms provided us with examples of domestic know-how licenses. In every case the item involved was a by-product of the firm's major R&D and production activities.

Because the licensor is ordinarily provided with various safeguards in the license agreement, probably there is more reason to be concerned about the licensee's position in the relationship. Firms are generally reluctant to accept technology from a technological rival. To do so on a limited basis and under the usual nondisclosure conditions might later block the licensee's independent entry or technological advance in the area of technology covered by the license agreement. Therefore, it seems likely that licensees will tend to be production-oriented firms with little or no rivalry with the licensor in an area of R&D. These firms need not be concerned with the possible disadvantages that an R&D-oriented licensee might encounter. For these reasons, directed licensing should not have much impact on the general characteristics of technological rivalry.

It may be worthwhile to sum up some of the essential provisions that would permit the use of technology licensing as an instrument of procurement policy. Suppose that a condition of an R&D contract with the Government calls for the recipient firm to provide a package of manufacturing technology and rights to any firm later designated by the Government to fill a reprocurement contract. The developer would be assured that such know-how licensing would not be required unless he failed to win the follow-on production contract. The amount of royalties to be paid in the event of technology transfer would be predetermined and stipulated in the original contract. When the time came for a follow-on production order, sufficient technical data would be disseminated to prospective suppliers to permit them to submit price quotations.

Questions naturally arise about the data that would have to be furnished prospective contractors at the time bids were solicited. Would transfer of technology have to take place before the competition in order to obtain meaningful price quotations? Would this result in the designer's technology being broadcast throughout the industry? What information is needed for a new prospective supplier to be able to bid?

Insight into these questions can be gained from the Navy's experience with second-sourcing programs for missiles, torpedoes, aircraft engines, and other items. It is the Navy's policy to provide all available data in which the Navy has rights to all prospective suppliers at

the time price quotations are solicited. However, it is customary that form, fit, and function specifications are used in place of the design details for contractor proprietary items. In addition, the engineering of some aspects of a system may not have been completed to the satisfaction of the Navy, in which case the Navy offers no assurance that production to the design drawings and .pecifications will yield a product that meets the required performance specifications. Even with these kinds of omissions or flaws in the engineering drawings, firms usually have been able to bid effectively and produce the item without serious difficulty.

The Navy experience suggests a likely way to handle the data aspects of a licensing policy. Essentially, it would call for the developer to provide prospective suppliers with a set of drawings and specifications in which his proprietary designs were replaced with form, fit, and function specifications. However, each prospective supplier would know that a full data package of the sort used commercially would be provided to the winner of the competition.

Each prospective supplier would also know the costs of obtaining know-how under license from the developer. The developer would have a pricing advantage in the competition equal to the amount of royalty payments that other firms would incur, as well as start-up and learning advantages. He would, nonetheless, know he was competing against rivals for the follow-on contract and competitive pressure would result.

On the adverse side of licensing, it must be recognized that interfirm technology transfers would have costs and would pose administrative burdens. Also, the contracts would need to be carefully written to give the developer adequate incentives to transfer his know-how and thereby to assure the proper flow of technology between firms.

The potential benefits of competition appear in two cost-saving forms. One is the avoidance of monopoly rent; the other is the avoidance of excess costs that arise from doing business with an ineffcient (rather than efficient) producer.* In any system where competition does not

*The distinction here is between an efficient producer operating in a competitive environment and a possibly inefficient one (one chosen on nonprice grounds) operating in an environment in which target costs

occur autonomously, the costs of simulating competition will tend to erode these cost-saving benefits. Directed licensing would attempt to place the Government in a position to avoid payments of monopoly rent. However, the adaptive response of the industry may be to raise all prices by all firms to offset the loss of monopoly rent due to directed licensing of technology.* This phenomenon may or may not occur; probably it will occur in limited degree. In any case, competitive benefits relating to interfirm variations in offer prices will remain. The question, of course, is whether the competitive benefits obtainable are large or small in relation to the costs of transfer.** If they are large, the benefits will be substantial. If they are small, directed licensing will prove to be an ineffectual (though substantially costless) policy innovation.

Of course, the competitive benefits of licensing may appear in other forms. The creation of multiple bases of technology may support parallel or competitive development in the future. More efficient transfers and uses of technology may also result. These factors could lead to long-run cost savings and to the creation of superior technical products.

In addition to the benefits of increased competition, directed licensing using commercial transfer techniques offers three attractive features. First, it would reduce the involvement of the Government with contractors by reducing the Government's role as an intermediary in the transfer process. Technology transfer would be primarily an interfirm matter governed by commercial practice and the law of contracts. Second, it would avoid the problem of trying to decide exactly what technology is proprietary -- a metaphysical exercise that has occupied too much of

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are based on estimates of the contractor's costs. Large interfirm variations in offer prices may also stem from uncertainty and short-run variations in pricing practices, plant capacity, and so on.

*A discussion of the adaptive behavior of firms is provided in Oliver E. Williamson, Defense Contracts: An Analysis of Adaptive Response, The RAND Corporation, RM-4363-PR, June 1965.

**A relevant discussion of this question is provided in Hall and Johnson, op. cit.

the energy of procurement officials. Finally, some of the data-management and transfer costs of present data policies would be avoided, while others would not be incurred unless the buyer were able to realize savings from the transfer that were over and above these costs.

VI. CONCLUSIONS

1. The new generation of data policies -- including revised rules for determining Government rights in data, predetermination of data rights, improved data requirements and standards, selective ordering of data, deferred ordering or delivery of data, and the coding and screening of parts and components for competitive procurement -- represents a major effort to solve some of the perennial problems of data management. If they work out as expected, they should greatly increase the efficiency of data acquisition, retrieval, and use, improve the quality of the data secured, reduce disputes with industry over rights in data, and curtail unnecessary acquisition of data. As such, they should reduce the costs while improving the overall performance of the data system. The screening and coding procedures are designed to facilitate the efficient transfer of standard data packages, consisting primarily of engineering drawings and specifications, for competitive reprocurement.

2. The current amount of competitive reprocurement resulting from data dissemination is small relative to the total reprocurement of parts, components, and other specialized hard goods. However, the dissemination of packages of reprocurement data does account for a sizeable fraction of all reprocurements that are now competitive. Improvement in the quality of data packages obtained under the new data policies should permit some enlargement of this fraction as time goes on.

3. Using commercial licensing techniques, U.S. aerospace firms have had vast experience in transferring production technology to firms that were not engaged in the original R&D efforts. In addition to engineering drawings and specifications -- the principal instruments of transfer used by the Government in the dissemination of reprocurement data -- commercial programs ordinarily call for the transfer of tool design information or actual tooling, production layout and process information, and engineering or technical assistance. These added elements in commercial transfers are generally considered essential in order to give the licensee proper access to the production technology.

4. Any substantial increase in competition in the reprocurement of weapon system components, accessories, support equipment and other

specialized items will require improved access to the developer's technology by other prospective suppliers. It is particularly important to provide more complete information about production techniques and processes that reflect the developer's accumulated learning. The adaptation of commercial licensing techniques to defense procurement under a policy of directed licensing is a promising way to improve access to technology.

5. As an instrument of defense procurement policy, directed licensing would be limited to situations in which the original producers were unable or unwilling to compete successfully for follow-on production contracts. Because a firm involved in R&D and early production possesses pricing and other advantages over other prospective suppliers, interfirm transfers of technology under directed licensing are unlikely in most situations. For the Government to obtain some of the benefits of competition, however, it would be unimportant whether production responsibility were actually transferred. The benefits would derive from the developer's awareness of the threat of competition for follow-on production orders.

6. In addition to competitive benefits, directed licensing using commercial transfer techniques offers other advantages. First, it would help reduce Government involvement with contractors, not only as a result of increased competition but also by reducing the Government's role as an intermediary in the transfer process. Technology transfer would be largely an interfirm matter governed by commercial practice and the law of contracts. It would also lessen or avoid many disputes over data rights -- the proprietary issues. Finally, some of the data-management and transfer costs of present data policies would be avoided, while others would not be incurred unless the buyer were able to realize savings from the transfer that were over and above the transfer costs.

Appendix A

PROCUREMENT METHOD CODING UNDER AFR 57-6

The various procedures of screening and coding embodied in AFR 57-6 and associated documents depend on whether a "new" or "old" system is involved -- a new system here meaning one whose procurement began after the commencement date for AFR 57-6 and associated programs, in 1965.

PROCEDURES FOR "OLD" SYSTEMS

For "old" systems, whose production runs and initial provisioning were largely complete by 1964, data files already existed in the central depository. The Air Force may have accumulated these under the plenary data requirement rules in effect in the early 1960's, or even earlier when data policies were vaguely defined. The data files for a given system or part may now be imperfect or incomplete, or the data may be suitable only for purposes other than production. When the inventory manager who is responsible for maintaining stocks of spare parts for a particular item of equipment at an AMA decides that the time has come to reprovision, he initiates a purchase request for a part or set of parts and sends it to the procurement offices of the AMA, which in turn sends it to the Material Management Office for engineering review. The latter calls out the data package from the data depository at Hq AFLC. Parts with an anticipated annual buy of over $2500 are given a full screening; others are screened only for known sources. When the data package arrives, the engineering division begins the screening and decides how to code the parts.

The numerical codes authorized by AFR 57-6 are shown in Table 8, along with the alphabetical or "alpha" codes used for internal control that indicate the screening office's evaluation of the data package and other circumstances affecting the mode of reprocurement. When the procurement request comes up for review, the item may already be in a monopoly procurement status, as when the contract clause governing data allows the contractor to claim proprietary rights in the data or when it limits Government use of the data because they were developed at

private expense. The engineering review ignores such legal questions; it considers only whether the data are suitable for competitive procurement and whether the item is "critical" and hence limited to designated sources of supply.* However, the contractor's claim of limited rights may well cover only certain manufacturing processes and private proprietary specifications for which the engineering offices can substitute MIL SPECS -- processing or material specifications from military manuals in the public domain. If the engineers are able to do this after further review, they may change the code on the items to a competitive one.

If the data packages are defective because of missing drawings or poor drawing quality, the procurement office may decide to buy more information from the contractor. The Operations Support Division describes what is wanted and obtains a price quotation from the contractor, after which it makes an "economic evaluation" of the probable benefits of securing competition for the item versus the cost of perfecting the data package. If its evaluation is favorable, it authorizes purchase of the data.**

This process may take several months. When the AMA needs an item in a hurry, it may bypass competitive procurement procedures and order it

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*Parts and components whose failure would severely impair the function of the equipment are critical to the success of the mission. The factors that are likely to make a part "critical" are detailed in the elements of the Alpha Code T in Table 8. Even if the Government judges an item to be critical, it does not have to reprocure the item from the original supplier. But it does have to qualify additional sources very carefully, and must usually leave in the hands of the prime contractor (or some designated "associate" contractor) the responsibility for system integration. Critical items cannot be advertised for competitive bids on firm-fixed-price contracts.

**At this stage the AMA is not purchasing <u>rights</u> to use data when the Government's rights are limited because of proprietary restrictions. It simply buys data in which it already has unlimited rights, its own files merely being defective because documents have been lost or defaced, etc. If the contractor is willing to quote prices at all, as he usually is, he charges as a rule only the cost of preparing the drawing requested. AFR 57-6, Supp. 1, gives this instruction to the procurement offices: "If a savings estimate is not available, it should be anticipated that introduction of competition will result in a gross savings of 25 percent."

from a sole source, meanwhile giving the data a suspense code "L" pending full review. It may later change the code to a competitive one for further reprocurement.

Once the AMA has a complete data package that it deems suitable for competitive production, it reproduces the data and distributes them with other material in soliciting competition from suppliers.

PROCEDURES FOR "NEW" SYSTEMS

For "new" systems, whose procurement began after the AFR 57-6 procedures went into effect, the Government considers breakout of spare parts and components either for direct purchase from vendors on a sole-source basis or for competitive procurement during provisioning. Provisioning consists of the series of decisions that determine what supplies of spare parts shall accompany or follow deliveries of the first production run of the weapon system to the Services, to support the system during its initial period of operations. The original prime contractor and vendors almost always supply the initial provision of spare parts. Some of these stocks may last for the life of the weapon system, though most do not, while many items must be reprocured very soon and bought repeatedly.

Representatives of the prime contractor and other original designers and suppliers, of the Air Force Systems Command, which has had buyer jurisdiction over design, development and initial production, of Air Force Logistics Command, which will have maintenance and support responsibility for the weapon system, and of the AMA of that command, which will be responsible for ordering spare parts and maintaining inventory levels, all try to agree during provisioning or soon thereafter on spare parts breakout. Their decisions will determine what data the Government will order or have on hand for reprocurement purposes. It was hoped, of course, that the 57-6 procedures would save unnecessary expense for data by restricting the Government's data requests to those items for which a data package would actually be useful. The Government would need only maintenance and cataloging information, not manufacturing data, for parts that were not coded for competitive reprocurement.

Decisions reached at the conferences and provisioning stages can subsequently be changed once reprocurement actually begins. The engineering staff at the AMA may decide that a part which was coded competitive is actually too "critical" to offer for competitive bidding, or conversely, it may find ways to substitute MIL SPECS for proprietary processes and change a code from "C" to "G". But in view of the fact that the Government will not acquire data packages suitable for manufacture when the preliminary screening has decided that an item is noncompetitive, the AMA may have no opportunity to perfect a data package for procurement. The decisions of the first screening authorities are likely to be controlling.

Table 8

PROCUREMENT METHOD CODES AND INTERNAL MANAGEMENT CODES
FOR SPARE PARTS BREAKOUT PROGRAM: AFR 57-6

1. Procurement Method Codes

Code 1 - Already competitive.
Code 2 - Competitive for the first time.
Code 3 - Already direct-purchase manufacturer (i.e., from vendor).
Code 4 - Direct-purchase manufacturer for first time.
Code 5 - Noncompetitive.

2. Internal Management ("Alpha") Codes

Code A - Screened for known or other qualified sources only.
Code B - To be assigned when the Government does not have the right to use available data for reprocurement from other sources.
Code D - Data not available or incomplete.
Code G - Technically suitable for advertising and data package complete.
Code H - Competition limited to known sources because data are incomplete or inaccurate.
Code K - Parts procured to military specification, military standards, military drawings, or military approved industry specifications or standards and items that are on Federal supply schedules.
Code U - Uneconomical to compete.
Code Z - Technical equipment requiring standardization and interchangeability of its parts in the public interest. Procurement by sole-source negotiation is necessary to insure standardization and interchangeability of parts.
Code L - The letter L will be used when the urgency of the procurement precludes normal screening action. It will be assigned to the purchase request only.

Table 8 -- continued

Code T - Technical considerations other than data preclude open or advertised competition. (By AFR 57-6, Supplement 1, dated 29 November 1966, the T code was replaced by the following codes designating procurement from specified sources for technical reasons other than data:)

(1) Code M -- Application of master or coordinated tooling is required to procure acceptable parts. These are parts with features (surfaces, holes, etc.) located according to a unique master reference tool. These are parts manufactured to minimal limits and must be replaceable without additional tailoring or fitting. Such parts cannot be manufactured or configured by secondary pattern or jigs independent of the master tool. They cannot be manufactured to requisite tolerance of fit by use of commercial precision machinery. Jigs and fixtures used only for ease of production will not be considered as master tooling.

(2) Code N -- Parts requiring special tests or inspection facilities. These are parts requiring ultra-precision or major special tests or inspection facilities or procedures which have been developed to determine and maintain ultra-precision or satisfactory quality for their individual function or system capability. Substantiation and inspection of the precision or quality cannot be accomplished without such specialized test or inspection facilities. Further, such specialized test or inspection facilities are of such magnitude, complexity, or peculiarity that other firms within the industry do not possess, nor would it be economically feasible for them to acquire, such facilities.

(3) Code X -- These parts are made from Class 1A castings or forgings. The process of developing and providing the acceptability of high integrity castings, such as Class 1 of MIL-C-6021 and similar-type forgings, requires repetitive performance by a controlled source for each casting or forging along identical lines to those which result in initial acceptability of the part. Thus, the particular manufacturer's process becomes the controlling factor regarding the acceptability of any such part. All Class 1A castings require 100 percent X-ray inspection and will therefore be identified. A 100 percent X-ray inspection requirement will not, of itself, preclude use of the competitive sources but will limit competition to sources with this capability.

(4) Code Q -- These parts require special processes or material control. They are used in critical applications requiring special, exceptional, or unique processes or material control, or both, in excess of the requirements published in applicable specifications. The requirements falling in this category are such that they cannot be depicted in detail to insure requisite quality and reliability.

Table 8 -- continued

(5) Code R -- These parts are subject to an excessively high rejection rate due to the developmental state of parts and materials or manufacturing state-of-the-art.

(6) Code V -- These parts require continuing control by the design activity of specialized manufacturing or inspection techniques, or both, because a reliability analysis (which includes an evaluation of the probability of component failure and the probability of catastrophic failure of any basic end part or control system part) indicates a probability of failure which would be unacceptable from the standpoint of safety-of-flight. The reliability analysis would be supported by operational field data or development test data, or both.

(7) Code O -- Manufacturing peculiarities other than M, N, Q, X, or R preclude open competition for these parts. These are parts for which there are special characteristics or peculiarities affecting manufacturing criticality, other than those specifically noted above. Detailed explanation will be included under "Remarks."

(8) Code Y -- Design of part is unstable. The design of an item is considered to be stable if its (or the components of which it is a part) engineering, manufacturing, or performance characteristics indicate that the required design objectives have been achieved to a degree whereby no major change is contemplated to "input," "output," or "form-fit-function" characteristics which would render the item obsolete and unusable in its present configuration.

SOURCE: AFSC/AFLC Supplement 1 to AFR 57-6, November 29, 1966.

Table 9

MANAGEMENT ACTION CODING IN THE REPROCUREMENT OF SPARE PARTS BY WARNER-ROBINS AIR MATERIEL AREA, FY 1966

1. Noncompetitive, Including Direct Purchases from Vendor

Management Action ("Alpha") Code		Purchases in Dollar Amounts
C	Government does not have right to use available data for reprocurement from competitive sources........................	$ 5,866,335
	From Vendors (Breakout) $ 3,006,198	
	From Prime Contractors $ 2,860,137	
D	Data not available or incomplete..........................	22,556,821
	From Vendors (Breakout) $ 6,070,206	
	From Prime Contractors 16,486,615	
H	Competition limited to known sources because data are incomplete or inaccurate; one source only....................	2,502,547
	From Vendors (Breakout) $ 1,678,471	
	From Prime Contractors 824,076	
L	Urgency of procurement precludes normal screening action.........	35,605,926
T	Technical reason (other than data) for using the specified sources.......................	20,202,018
	From Vendors (Breakout) $ 6,426,453	
	From Prime Contractors 13,775,565	
	Not screened because of small dollar volume of requirement...	21,518,26[illegible]

Table 9 -- continued

All other reasons for non-competitive procurement (standardization, uneconomic to compete, etc.).............	1,538,926
Total Noncompetitive (63.8%)	$109,790,857

2. <u>Competitive</u>

Management Action ("Alpha") Code		Purchases in Dollar Amounts
C	Government has limited rights in data, but item procured competitively..................	$ 810,294
D	Data incomplete, but item procured competitively...........	1,601,081
G	Technically suitable for advertising and data package complete......................	13,794,335
H	Competition limited to known (established) sources because data incomplete or inaccurate..	798,485
K	Parts procured to military specifications, standards, or drawings...................	37,775,343
L	Urgent procurement, not screened but procured competitively....................	4,783,335
T	Technical reason (other than data) for using specified sources, but procured competitively	2,651,350
	All other...............	171,334
	Total Competitive (36.2%)	$ 62,385,557
	Overall Total (100.0%)	$172,176,414[a]

[a] Does not include $18,745,374 for modification kits, special projects, and other procurements not classified as Replacement Spare Parts.

SOURCE: Warner-Robins Air Materiel Area statistical records.

Appendix B

ILLUSTRATIVE PROBLEMS WITH DATA TRANSFER IN COMPETITIVE REPROCUREMENT

This Appendix describes some typical problems involved in competitive reprocurement. The data were gathered from San Antonio Air Material Area.

MISSING DIMENSIONS

On Contract No. 41(608)32491 for guide assemblies, December 1964, the Precision Manufacturing Company found that two dimensions were missing from the drawings originally prepared by Republic Aviation Company. By making a complete layout, and with Air Force assistance, the firm completed the engineering. But contract performance was delayed about a month.

INCORRECT DIMENSION

On Contract No. F41(608)-67-C-4390 for an aircraft engine stand for B-52 aircraft, October 1966, the Precision Manufacturing Company discovered one incorrect dimension on a Boeing drawing -- 7.03 instead of 7.50. Contract performance was not delayed.

OBSOLETE PROCESS

On Contract No. F41(608)-67-D-1451 for a pin assembly, August 1966, the Jones Tool & Machine Company found that the drawings prepared by Douglas Aircraft Company, the original designer, called for an obsolete method of welding. Jones suggested substituting another, and the Air Force agreed, covering the new method with a MIL SPEC.

DETAIL MISSING FROM DRAWING

On Contract No. F41(608)-67-D-5702, 1966, the Stinson Manufacturing Company inspected a sample of the truck lift fenders covered by the contract and discovered that it was equipped with two quick-connect receptacles not shown on the USAF drawing. They had to be added at moderate extra cost.

MATERIAL SPECIFICATIONS POSSIBLY INCORRECT, AND CONTOUR INFORMATION MISSING

On Contract No. 41(608)37391 for intake screens, December 1965, the Stinson Manufacturing Company had trouble with the materials called for by the Convair drawings. They specified heat-treating of .028 diameter aluminum wire cloth to a temper hardness of 6, which proved to be impossible. Stinson expressed doubt that Convair had actually used that diameter and hardness. Also, the drawings failed to give contour information, which had to be obtained from a screen taken from the aircraft and used in a mock-up. Stinson could not get the necessary rubber seals from the vendor for the mock-up, and was only able to shape and build the screen by simulating the seals with adhesive tape. The contract became delinquent in July 1966.

DESIGN OF CASTING

On Contract No. 41(608)40640, April 1966, the Wichita Engineering Company used Douglas Aircraft Company drawings to manufacture a towbar for C-124 aircraft. Wichita's casting subcontractor, Smith Steel Casting Company, had difficulties with the "peculiar design of the casting." Smith Company asserted that considerable pattern revision and procedure changes were required to produce acceptable castings.

INCOMPLETE SPECIFICATIONS AND ATTEMPTED REVERSE-ENGINEERING

On Contract No. 41(608)41782, Lockheed drawings of an aircraft boarding ladder were turned over to Fleet of America, Inc., which also requested a sample because the data package was incomplete. The sample ladder had been repaired, and Fleet was unable to duplicate the original ladder exactly. The specifications called for the ladder to bear an 800 lb perpendicular load, but the sample ladder would not bear more than 600 lbs.

INCORRECT DIMENSION

On Contract No. 41(608)39141 for engine-type slings for an R4360-20W engine, February 1966, the Regent Jack Manufacturing Company used Douglas drawings which called for rivets that turned out to be too short. The contractor had to substitute another rivet specification which delayed delivery of the item and caused extra cost.

ERRONEOUS MATERIAL SPECIFICATION

On Contract No. 41(608)38306 for a lock assembly, main landing gear door, August 1966, the Boeing drawings called for flat brass, whereas Tubular Aircraft Products found it necessary to use brass rod to meet the design requirements.

FAILURE TO UPDATE DATA PACKAGE

On Contract No. 41(608)-67-D-7032 for a guide, June 1966, the A & K Manufacturing Company had trouble with the Air Force drawing. It turned out that the size of a pilot hole had been changed on another part that had to match up exactly with the guide, but this drawing had not been changed accordingly.

FAILURE TO UPDATE DATA PACKAGE

On Contract No. AF04(607)9956, October 1965, Regent Jack was the successful bidder on a hoist, applicable to C-124, originally designed by Douglas. It had not been procured since 1955. During fabrication, Regent Jack found that the hoist would not fit the aircraft. The reason was that the latest drawing revisions had not been included in the data package. Revised drawings (numbered the "J" revision) were requested from Douglas. Regent threw away 184 parts made under the "D" revision and made 184 new ones under the "J" revision. The change cost the Government an extra $9,000 (the original value of the contract was approximately $16,000) and nine months delay.

OBSOLETE DESIGN OF COMPONENT PARTS

On Contract No. 41(608)35949, 1965, American Machine and Foundry attempted to fabricate an arresting barrier engaging device BAK-11/F from Air Force drawings. It had trouble with premature firing of quick-opening valves which were part of this device. A sample valve obtained from Edwards AFB showed appreciable differences in design; the USAF drawings were apparently out of date. Modification (installing springs on valves, etc.) cost over $50,000 extra on the contract.

DETAIL MISSING FROM DRAWINGS

On Contract No. 41(608)33015, December 1964, Aero Engineering tried to fabricate a manifold assembly from Aircraft Production Company drawings. The Air Force rejected the ten units shipped because of lack of vent holes. The contractor protested that there was no reference to vent holes in the specifications or drawings and no indication of the size or location of them.

INADEQUACY OF DEVELOPMENT DATA FOR PRODUCTION

During the Skybolt Program development phase, Standard Manufacturing Company got an R&D contract for an MHU-33/M munitions handling trailer. The prototype trailer was 75 percent complete when Skybolt was cancelled. The existing drawings were only 50 percent complete, and were not production drawings. The Air Force completed the trailer without engineering data, and tried to complete the data package from the hardware. Later it decided to procure a modification of the trailer, modified the drawings, and offered the package for competitive bidding. The contractor found that the engineering drawings were unsuitable for production. Some 400 changes had to be made in the drawings after the contract award.

VENDOR ITEM UNAVAILABLE

Furmont Manufacturing got a contract for MJ-1 loading units in 1963. The Standard Manufacturing Company drawings called for a hydraulic steering mechanism made by MOPAR primarily for Chrysler. By the time this contract was let, MOPAR had ceased to manufacture this item. The Air Force had to devise a substitute.

INADEQUATE MATERIAL AND DESIGN SPECIFICATIONS

On Contract No. 41(608)36938, November 1965, the Precision Manufacturing Company agreed to produce 20mm ammunition loader parts from Air Force drawings. These loaders had previously been manufactured by Republic. Some of the delivered articles failed inspection because of bending and undue surface roughness. Inspection showed that the plating was not nickel as it was supposed to be, and was too thin. It turned out that nickel plating had been authorized to expedite production, but the drawings in the data package had called for chrome. The items

apparently did conform to these drawings, which were USAF redesigns of parts that had not worked properly in Republic's original loader. The Air Force had manufactured a redesigned prototype which had performed satisfactorily. The procurement office had considerable difficulty in finding out just what was wrong with Precision's parts.

Appendix C

MAJOR AEROSPACE LICENSE AGREEMENTS

The table which follows is divided into three parts: aircraft, aircraft engines, and missiles, each arranged in alphabetical order by licensor. Only those agreements under which production has taken place or where there is considerable evidence that production plans will be executed have been included in the list. The intent has been to concentrate on programs involving major and technically complicated items. Therefore, most utility and light aircraft programs have been excluded.

The terms "licensor" and "licensee" have been used somewhat loosely. The firm which designed and originally manufactured the item is shown as licensor. The firm which manufactured the item according to the licensor's design is shown as licensee. The fact that a government may have represented one or the other of the parties in the actual license is disregarded.

The name of the firm as of the time of the license is ordinarily shown, even when firms have merged or otherwise changed their identity. For example, the Magister licenses are listed under Potez, although that firm has since merged with Sud Aviation. In the case of BAC and the other consolidated British firms, the various divisions which correspond to the former firm names have been listed separately as subheadings under the new firm name. Bristol-Siddeley and Rolls-Royce are still listed as separate entities, since the consolidation took place so recently. In the case of consortia for licensed production, if no one firm was specified as the prime contractor the licensee is shown as that firm designated for the final assembly and testing. The model description given is that used by licensee and, where available, the name or model number used by the licensor is shown in parentheses.

The table is subject to various inaccuracies. The year of the license agreement could not always be established with accuracy. Production starting dates are sometimes used instead and are so indicated. Production figures were often hard to come by. For some categories, such as missiles, they could not be established for security reasons.

In some programs production was divided between different firms and different countries. While care has been taken to avoid double counting as far as possible, such as in the European F-104G program, double counting may have resulted in some cases where aerospace firms in one country were manufacturing parts for assembly in another country. Assembly activities were also troublesome. In many cases the licensor shipped knocked-down airframes for assembly by the licensee at the inception of the program, to be followed by manufacture of parts by the licensee. While assembly activities were not included in production figures deliberately, adequate information was not always available. Therefore, some production figures may be inflated.

The major sources of data were: Aircraft Industry Record, Jane's All the World's Aircraft, Flying Review International, and Interavia.

Table 10

MAJOR AEROSPACE LICENSE AGREEMENTS

A. Aircraft

Licensor	Country	Licensee	Country	Year of Lic.	Product	No. Produced
Beagle Aircraft	U.K.	OGMA	Portugal	1960	Training Auster D4/D5	150
Beechcraft	U.S.A.	Fuji	Japan	1953	Primary trainer Mentor 34A	160
Bell	U.S.A.	Agusta	Italy	1952	Helicopter Agusta-Bell 47 series	1,240
Bell	U.S.A.	Agusta	Italy	1960	Helicopter Agusta-Bell 204 and 205 series	330
Bell	U.S.A.	Fuji (sublicensee under Mitsui)	Japan	1961	Helicopter (utility) (204B)	204[a]
Bell	U.S.A	Kawasaki	Japan	1953	Helicopter (Bell Model 47 series)	290
Bell	U.S.A.	Westland	U.K.	1960	Helicopter Sioux AH Mk. 1 (Agusta-Bell 47-3B-1)	100
Boeing	U.S.A.	Douglas	U.S.A.	1951	Bomber B-47	252
Boeing	U.S.A.	Lockheed	U.S.A.	1951	Bomber B-47	300
Boeing	U.S.A.	Kawa Aki	Japan	1959	Helicopter KV 107 Model II	37
British Aircraft Corp.						
BAC (now Filton Div.)	U.K.	Canadair	Canada	1954	Maritime reconnaissance (Brittania) CL 28 Argus	37
BAC (now Filton Div.)	U.K.	Canadair	Canada	1956	Civil. and mil. transport (Brittania) CL 44	39
BAC	U.K.	Short Bros.	U.K.	1953	Brittania	30
English Electric (now Preston Div.)	U.K.	Government Factories	Australia	1953	Twin-jet bomber Canberra B.Mk. 20	48
English Electric	U.K.	The Martin Co.	U.S.A.	1951	Tactical bomber B-57	403
Vickers Armstrongs (now Luton Div.)	U.K.	HAL	India	1948	Trainer T-3	62
Cessna	U.S.A.	Fuji	Japan	1956	Observation aircraft L-19	50
Dassault	France	C.A.C.	Australia	1960	Jet fighter Commonwealth CA-29 (Mirage III-O)	100[a]
Dassault	France	Federal Aircraft Factory	Switzerland	1960	Mirage III-S; Mirage III-RS	50[a]
Dornier	Germany	CASA	Spain	1955	Monoplane CASA 127 (Do 27)	50
Fiat	Italy	ARGE 91	Germany	1959	Jet fighter G 91 R/3	244
Fokker	Netherlands	Aermacchi	Italy	1950	Instructor MB 416 (Fokker S.11)	[illegible]
Fokker	Netherlands	Fairchild-Hiller	U.S.A.	1956	Twin turboprop airliner F 27	[illegible]
Grumman	U.S.A.	De Havilland	Canada	1954	Twin engine submarine tracker CS2	[illegible]
Hawker Siddeley Group:						
A. V. Roe	U.K.	HAL (Kanpur Div.)	India	1960	Short/medium-range airliner (turboprop) (Hs 748) HS 748 Series 2	44
De Havilland	U.K.	SNCA-SE (now part of Sud)	France	1950	Jet fighter Vampire FB 53	[illegible]
De Havilland	U.K.	SNCA-SE (now part of Sud)	France	1950	Jet fighter Mistral	[illegible]
De Havilland	U.K.	SNCA-SE (now part of Sud)	France	1954	Jet fighter S.E. Aquilon	140
De Havilland	U.K.	OGMA	Portugal	1951	Primary trainer (Chipmunk)	[illegible]

[a]Planned production.

Table 10 (Continued)

Licensor	Country	Licensee	Aircraft Country	Year of Lic.	Product	No. Produced
De Havilland	U.K.	HAL	India	1954	Jet fighter (Vampire)	200
De Havilland	U.K.	HAL	India	1956	Trainer (Vampire T-55)	20
Folland	U.K.	HAL	India	1956	Trainer (Gnat Mk. 1)	190[a]
Folland	U.K.	Valmet	Finland	1951	Trainer (Gnat Mk. 1)	20[a]
Hawker	U.K.	Fokker	Netherlands	1950	Jet fighter (Sea Fury)	20
Hawker Siddeley Group	U.K.					
Hawker	U.K.	Fokker	Netherlands	1950	Jet fighter (Gloster Meteor Mk. 8)	348
Hawker	U.K.	Fokker	Netherlands	1950	Jet fighter (Hunter F. Mk. 466)	460
Hawker	U.K.	Avions Fairey (joint production with Fokker)	Belgium	1953	Jet fighter (Hunter F. Mk. 4)	140
Lockheed	U.S.A.	Kawasaki	Japan	1954	Jet trainers T-33A	210
Lockheed	U.S.A.	Kawasaki	Japan	1954	Jet trainers T-33	33
Lockheed	U.S.A.	Kawasaki	Japan	1958	Antisubmarine A/C P2V-7 Neptune	48
Lockheed	U.S.A.	Macchi	Italy	1956	Light utility transport Al 60-B2	100
Lockheed	U.S.A.	Macchi	Italy	1956	Light utility transport Al 60-C4	N.A.
Lockheed	U.S.A.	ARGE Sued (Messerschmitt, Heinkel, Siebelwerke, Dornier)	Germany	1959	Multimission Fighter F-104G	210
Lockheed	U.S.A.	ARGE Nord (Fokker (Dutch), Aviolanda (Dutch), Hamburger Flugzeugbau (German), V.F.W. (German))	Germany - Netherlands	1959	F-104G	350
Lockheed	U.S.A.	SABCA and Avions Fairey	Belgium	1960	F-104G	159
Lockheed	U.S.A.	Fiat and Macchi	Italy	1961	F-104G	229
Lockheed	U.S.A.	Mitsubishi	Japan	1960	F-104J	207
Lockheed	U.S.A.	Canadair	Canada	1959	CF-104	200
Lockheed	U.S.A.	Fiat	Italy	1965	F-104S	165[a]
Nardi	Italy	Siai-Marchetti	Italy	1950	Four-seat amphibian FN-333	13
Nord	France	Nordflug (Hamburger Flugzeugbau, Siebelwerke, "Weser" Flugzeugbau	Germany	1956	Transport (military) Nord 2501 Noratlas	161
North American	U.S.A.	Canadair	Canada	1949	Fighter Sabre Mk. 1 through 7	1,815
North American	U.S.A.	C.A.C.	Australia	1951	Fighter Sabre CA-27	112
North American	U.S.A.	Mitsubishi	Japan	1956	Fighter F-86F	300
North American	U.S.A.	Fiat	Italy	1953	Fighter F-86K	231
Northrop	U.S.A.	CASA	Spain	1966	Jet fighter F-5A	36[a]
Northrop	U.S.A.	CASA	Spain	1966	Jet fighter F-5B	12

[a]Planned production.

Table 10 (Continued)

Licensor	Country	Licensee	Aircraft Country	Year of Lic.	Product	No. Produced
Piaggio	Italy	Focke-Wulf	Germany	1955	Trainer (piston) P. 1[illegible]0	265
Pilatus	Switzerland	Fairchild-Hiller	U.S.A.	1964	Single-engine utility plane Pilatus PC-6/B-H2	100
Potez (Now part of Sud)	France	Flugzeugunion Sued (Heinkel and Messerschmitt)	Germany	1956	Jet trainers C.M. 170 Magister	188
Potez (Now part of Sud)	France	Valmet	Finland	1958	Jet trainers C.M. 170 Magister	57
Potez (Now part of Sud)	France	IAI	Israel	1958	Jet trainers C.M. 170 Magister	36
Sud Aviation	France	HAL	India	1962	Helicopter (Alouette III)	100[a]
UAC - Sikorsky	U.S.A.	Mitsubishi	Japan	1958	Utility helicopter (S-55)	44
UAC - Sikorsky	U.S.A.	Mitsubishi	Japan	1960	Large commercial transport helicopter (S-61)	2
UAC - Sikorsky	U.S.A.	Mitsubishi	Japan	1960	Amphibious helicopter (S-62)	
UAC - Sikorsky	U.S.A.	Mitsubishi	Japan	1960	Antisub helicopter SH-3A (S-61B)	23
UAC - Sikorsky	U.S.A.	Westland	U.K.	1947	Hel. Dragonfly Mk. 1 through 4	133

[a]Planned production.

Table 10 (Continued)

B. Aircraft Engines

Licensor	Country	Licensee	Country	Year of Lic.	Product	No. Produced
AVCO - Lycoming Div.	U.S.A.	Piaggio	Italy	1952	Piston engine (VO-435) Piston engine (GSO-480)	2[illegible]
AVCO - Lycoming Div.	U.S.A.	Klockner-Humboldt	Germany	1962	Piston engine (T-5[illegible]	563[a]
AVCO - Lycoming Div.	U.S.A.	BMW	Germany	1957	Piston engine GO-480-B1A6	400
Bristol-Siddeley Engine Co. (includes the former Bristol-Aero-Engines, Armstrong-Siddeley Motors De Havilland Engine Co., Blackburn Engines, Ltd.)	U.K.	HAL	India	1956	Turbojet (Orpheus 703 and 701)	357
Bristol-Siddeley Engine Co.	U.K.	Fiat	Italy	1957	Single-spool turbojet Fiat 4023 and 4024 (Orpheus 803) for G91	N.[illegible]
Bristol-Siddeley Engine	U.K.	Klockner-Humboldt-Deutz	Germany	1958	Turbojet Orpheus 803 D. 11	200
(De Havilland)	U.K.	Fiat	Italy	1949	Fiat Ghost 48 Mk. 1	280
(De Havilland)	U.K.	Flygmotor	Sweden	1947	Jet engine RM2B Jet engine RM2	900
(Armstrong-Siddeley)	U.K.	Curtiss-Wright	U.S.A.	1950	Turbojet J65 (Sapphire 100 series)	13,000
(Armstrong-Siddeley)	U.K.	Piaggio	Italy	1960	Turbojet (Viper ASV 11)	100[a]
(Armstrong-Siddeley)	U.K.	SNECMA	France	1947	Sleeve valve engine (Hercules 750)	1,200
Continental Motors	U.S.A.	Rolls-Royce Ltd.	U.K.	1960	Piston engine Rolls-Royce-Continental 0-200-A 0-300 G10-470-A	2,000
General Electric	U.S.A.	De Havilland Engine Co. now Bristol-Siddeley	U.K.	1958	Free turbine power unit T58 (USA) Gnome H. 1000 - 1800	N.A.
General Electric	U.S.A.	Ishikawajima	Japan	1960	Turbojet J79-IHI-11A	19[illegible]
General Electric	U.S.A.	Ishikawajima	Japan	1960	Shaft turbine T58	212[a]
General Electric	U.S.A.	Ishikawajima	Japan	1960	Turboprop T64	...
General Electric	U.S.A.	Orenda (now part of Hawker-Siddeley)	Canada	1959	Turbojet J79-OEL-7	400[a]
General Electric	U.S.A.	Orenda	Canada	1962	Turbojet J85-CAN-40	N.A.
General Electric	U.S.A.	Fabrique Nationale	Belgium	1960	Turbojet J79-GE-11A	300
General Electric	U.S.A.	BMW	Germany	1957	Turbojet J79-GE-11A	966
General Electric	U.S.A.	Fiat and Alfa Romeo	Italy	1960	Turbojet J79-GE-11A	26[illegible]
Pratt and Whitney	U.S.A.	SNECMA	France	1959	Turbofan (P&W JTF 10) SNECMA TF 106	N.A.

[a]Planned production.

Table 10 (Continued)

Aircraft Engines

Licensor	Country	Licensee	Country	Year of Lic.	Product	No. Produced
Pratt and Whitney	U.S.A.	SNECMA	France	1959	Turbofan (P&W TF 30) SNECMA TF 306	N.A.
Pratt and Whitney	U.S.A.	Flygmotor	Sweden	1962	Turbofan (P&W JT8D-1) Flygmotor RM8	370[a]
Pratt and Whitney	U.S.A.	C.A.C.	Australia	--	Piston engine P&W R-1340-S3H1G	680
Pratt and Whitney	U.S.A.	C.A.C.	Australia	--	Piston engine P&W R-1830-C3	870
Rolls-Royce	U.K.	HAL	India	1961	Turboprop RR Dart 531	N.A.
Rolls-Royce	U.K.	Pratt and Whitney	U.S.A.	1947	Turbojet (Nene) J-42	N.A.
Rolls-Royce	U.K.	Pratt and Whitney	U.S.A.	1947	Turbojet (Tay) J-48	N.A.
Rolls-Royce	U.K.	Hispano-Suiza	France	1946	Turbojet Nene 102/3/4/5	1,250
Rolls-Royce	U.K.	Hispano-Suiza	France	1951	Turbojet Tay 250	600
Rolls-Royce	U.K.	Hispano-Suiza MAN Fabrique Nationale	France Germany Belgium	1956	Turboprop (Tyne) RTy.21 for Atlantic RTy.22 for Transall	 120[a] 470[a]
Rolls-Royce	U.K.	Fabrique Nationale	Belgium	1949	Turbojet Derwent	1,200
Rolls-Royce	U.K.	Fabrique Nationale	Belgium	1954	Turbojet Avon 100 series 200 series	1,000
Rolls-Royce	U.K.	C.A.C.	Australia	1947	Turbojet Nene Z-VH	114
Rolls-Royce	U.K.	C.A.C.	Australia	1947	Turbojet Avon Mk. 20	218
Rolls-Royce	U.K.	Flygmotor	Sweden	1952	Flygmotor RM6 Avon	300
SNECMA	France	C.A.C.	Australia	1960	Gas turbine Atar 9	N.A.
SNECMA	France	C.A.C.	Australia	1961	Gas turbine Atar 9	N.A.
Turbomeca	France	ENMA	Spain	1954	Turbojet (Marbore II) Marbore M21	N.A.
Turbomeca	France	Bristol-Siddeley (Blackburn)	U.K.	1952 renewed 1961	Small turbojet Blackburn-Turbomeca Palas 600 Shaft turbine Blackburn-Turbomeca Turmo 600 Shaft turbine Blackburn-Turbomeca Artouste 600 & 510	1,000+
Turbomeca	France	Continental	U.S.A.	1952	Range of Turbomeca gas turbine engines long life version J69-T-25 Short life version J69	6,000+

[a]Planned production.

Table 10 (Continued)

C. Missiles

Licensor	Country	Licensee	Country	Year of Lic.	Product	No. Produced
Hughes	U.S.A.	SAAB	Sweden	1960	Air-to-air missile RB 27 (HM 55) RB 28 (HM 58)	N.A.
Martin	U.S.A.	Kongsberg Consortium	Norway	1962	Air-to-surface missil. USA designation AGM 12	N.A.
N.O.T.S.	U.S.A.	Bodenseewerke Perking-Elmer	Germany	1959	Air-to-air missile Sidewinder (AIM - 9B)	9000[a]
Raytheon	U.S.A.	S.E.T.E.L. (S.E.T.E.L. is the prime contractor, co-ordinating the activities of the five national prime contractors: Telefunken (Germany), Construction Electriques de Charleroi (Belgium), Thomson-Houston (France), Finmeccanica (Italy), Philips (Netherlands))	France	1959	Surface-to-air guided weapon Hawk (MIM-23A)	N.A.

[a]Planned production.

Appendix D

DATA FURNISHED MITSUBISHI HEAVY INDUSTRIES, LTD.

BY NORTH AMERICAN AVIATION, INC.,

FOR THE F-86F PROGRAM

A. COMPLETE ENGINEERING DATA

Item	Description
1	Two (2) print sets of Basic Lines Reproduction (full scale reproductions on metal).
	NOTE: Basic Lines boards delineate the air surface and are made on metal. The full size basic lines will be forwarded on metal. Any other sizes such as 1/2, 1/4, 1/8, etc., will not be on metal.
2	Two (2) print copies of Stress Analysis Data.
	NOTE: The stress analysis data contains an analytical investigation of the structural strength of the airplane.
3	Two (2) print copies each of pertinent Airplane Weight Reports.
	NOTE: The pertinent weight reports will give the various weights of the components of the airplane in detail.
4	One (1) reproducible copy of all production engineering drawings, including Finish Specifications, Airplane Special Tools, Airplane Ground-Handling Equipment, Engineering Orders, and Numerical Drawing Index.
	NOTE: The data to be forwarded for this item will be all North American production drawings for the manufacture of the airplane including finishing specifications. The finishing specifications denote the type of protective finish to be used on the various components of the airplane. Also, drawings will be forwarded for the North American designed special tools and ground handling equipment which are required for the maintenance of the airplane. Engineering Orders will be forwarded also, and are used to release requirements, distribute drawings and process specifications, and also make and authorize minor changes to a drawing previously released. The numerical drawing index is a listing of the drawings of the parts to be used in the airplane including vendor parts. Drawings of vendor items, Government Furnished Aircraft Equipment and Government drawings and other Government documents (except as specified in this Exhibit A) will not be furnished by North American and, if required, must be obtained by Mitsubishi direct from the Government and/or the applicable vendor.
5	Two (2) print copies each of pertinent Flight Test Reports.
6	Four (4) copies of Flight Handbook (Government T.O.).
	NOTE: This Government Technical Order describes a pilot's operating instructions for the airplane, including mechanical and flight limitations.
7	Four (4) copies of the Handbook of Erection & Maintenance (Government T.O.).

NOTE: The Erection & Maintenance Manual is a Government Technical Order, and denotes the procedure to maintain the airplane.

8 Four (4) copies of the Handbook of Structural Repair (Government T.O.).

NOTE: The structures repair manual is a Government Technical Order, and denotes the method of repairing the structure of the airplane.

9 Four (4) copies of the Illustrated Parts Catalog (Government T.O.).

NOTE: The Illustrated Parts Catalog is also a Government Technical Order, and lists the serviceable parts of the airplane that commonly require replacement.

10 Four (4) copies of Handbook of Basic Weight Check List and Loading Data (Government T.O.).

NOTE: This handbook describes proper loading of the airplane for the purpose of safe flight operations.

11 Four (4) copies of Handbook of Aircraft Inspection Requirements (Government T.O.).

NOTE: This handbook is a Government Technical Order, and discloses the inspection requirements and procedures of the airplane.

12 Five (5) printed copies of Drafting Room Manuals.

13 One (1) reproducible copy of applicable standards drawings, including North American NAS AN-AF (3 digit only) and MS standards.

NOTE: Standard drawings in the categories listed above which are used on the airplane will be forwarded. Standard drawings are drawings of parts usually made in quantity and that are common to many aircraft.

14 One (1) reproducible copy of applicable Process Specifications including Master Dimension Specifications.

NOTE: Process Specifications are engineering instructions written primarily for the benefit of North American manufacturing departments, and establish shop methods or procedures that are essential in insuring the proper function of parts and equipment in the finished product. The Master Dimension Specification contains the coordinate data defining the air surface, structural components, and includes kinematics of the internal mechanism of the airplane.

15 One (1) reproducible copy of the Airplane Model Specifications with applicable amendments.

NOTE: The Model Specification is a detailed description of the items being incorporated within the airplane.

16 Two (2) print copies each of Miscellaneous Engineering Analysis and Test Reports.

NOTE: Miscellaneous Engineering and Laboratory Test Reports applicable to the airplane (aerodynamic calculations-wind tunnel, tests-analysis reports, etc.).

17 Four (4) print copies of Structural and Salvage Repair Manual, Report NA-1739.

NOTE: The structures and salvage repair manual incorporates the most commonly occurring discrepancies from the drawings during manufacture and denotes the method of salvaging such discrepancies without recourse to the engineering department.

18 Two (2) sets of miscellaneous airplane photographs.

19 Two (2) sets of Surface Roughness Specimen booklets.

NOTE: These booklets have a plastic gage to check the surface roughness of machine finishes. The remainder of this booklet is concerned with a discussion of types of surfaces and methods of producing, measuring, and comparing them.

20 Two (2) print copies of the Engineering Loft Manual.

NOTE: The Loft Manual contains the techniques of the graphic development of the air surface of an airplane.

21 Two (2) print copies of North American's Buyer's Guide Bulletins.

NOTE: The Engineering Source Approval Bulletin is commonly called the Buyer's Guide Bulletin and denotes the approved sources to the Purchasing Department from which material may be procured.

22 Four (4) copies of Engineering Procedures Manual.

NOTE; This manual outlines general phases of engineering procedure followed by North American.

23 Miscellaneous Publications and Data.

24 One (1) reproducible copy of applicable North American Material and Equipment Specifications.

NOTE: The equipment specifications are prepared for equipment called out on production drawings when control by such specifications is desirable, and when no existing Government or other industry-wide specification is considered adequate. Material specifications are prepared for materials called out on production drawings when control for such specifications is desirable. These material specifications contain information on both the materials not appearing on the complete airplane, and those that cover raw materials from which finished parts are manufactured for the airplane.

B. PRODUCTION DATA

Item	Description
1	One (1) reproducible copy of available tool drawings (designed by North American).
	NOTE: These drawings will cover all North American-designed detail parts and assembly tool drawings.
2	One (1) reproducible copy of Tooling Breakdown.
	NOTE: This illustration portrays the sequence in which major tools are utilized in production.
3	One (1) reproducible copy of each available Tool Design Manual.
	NOTE: This manual establishes design standards for the tooling division.
4	Two (2) printed copies of Tool Master Book.
	NOTE: This book constitutes perspective drawings of tool masters and their relation to each other.
5	One (1) printed copy of information for use on Spar Mills.
	NOTE: This information will indicate setup data on spar mills.
6	Two (2) photographs of major and large subassembly tooling.
	NOTE: Self-explanatory.
7	One (1) reproducible copy of designs or photographs of utility items as required and designed since February 1947.
	NOTE: "Utility" and "standard" items of tooling are those having application to all contracts (dimple sets, air feed drills, drill motors, etc.).
8	One (1) set of printed Master Template Cards.
	NOTE: Master Template Cards reference part number to master template layout number. Individual parts are frequently a portion of a master loft layout resulting in the need of a cross reference system.
9	One (1) printed set of Production Work Orders.
	NOTE: Work Orders reflect routing in fabrication departments and processing.
10	One (1) printed set of Sign Off Books.
	NOTE: Sign Off Books show the control points for inspection and installation sequence.
11	One (1) set of Operation Manuals (as available) to be used in conjunction with Sign Off Books.
	NOTE: Operational functions are detailed to insure proper functioning of installations.

12 One (1) printed set of Change Verification Procedures and Sample Forms.

NOTE: This is an internal procedure for verifying the incorporation of engineering changes on the airplane.

13 Two (2) printed sets of Planning Manuals.

NOTE: Planning Manuals define production planning policies.

14 Two (2) lists of Standard Tools designed by North American (as required).

NOTE: Standard tooling differs from contract tooling in that it has universal application. These instances will be defined upon request.

15 Two (2) printed copies of the Scheduling Manual.

NOTE: Scheduling Manuals indicate North American scheduling policies.

16 One (1) printed copy of Manufacturing Flow Charts.

NOTE: Manufacturing Flow Charts illustrate stationization of assembly departments.

17 Two (2) printed copies of Final Assembly Departmental and Major Assembly Departmental Layouts.

NOTE: Self-explanatory.

18 Two (2) copies of inventory and related data on Supplemental Tooling, Materials Handling Equipment, Pickup Stands, Work Platforms, and Conveyor Systems.

NOTE: Self-explanatory.

19 Two (2) lists by type and related data of assembly and parts transportation handling equipment.

NOTE: Self-explanatory.

20 Two (2) copies of inventory and related data of Flight Test Equipment.

NOTE: Self-explanatory.

21 Two (2) inventories and related data of Final and Major Assembly Functional Test Equipment.

NOTE: Self-explanatory.

22 Two (2) lists of specialized machinery and equipment utilized for detail parts manufacture.

NOTE: Self-explanatory.

23 Two (2) copies of Hydraulic Manual.

NOTE: This is a handbook showing hydraulic installations. The flow, functions, and procedures are defined thoroughly.

24 One (1) reproducible copy of each electrical wiring jig print.

NOTE: The electrical wiring jig print referred to is a print of the jig board which would enable a subcontractor to fabricate a plywood board indicating terminals, wire lengths, etc., which constitute a specific wire harness.

25 Two (2) printed copies of electrical job procedures.

NOTE: For building wire assemblies, a step-by-step breakdown of operations necessary to assemble each wire harness is prepared. The information covered under this item is a printed copy of these job procedures.

26 One (1) reproducible copy of Electric Wire Book.

NOTE: This information consists of a list of all wires referencing the type of wire, length of wire, types of terminals, etc., required to fabricate harnesses for the specific model in question.

27 One (1) reproducible copy of Electrical Hookup Manual.

NOTE: This item illustrates the proper hookup of wire panels in the installation department.

28 Two (2) sets of photographs of electrical installations.

NOTE: This item illustrates by photograph the electrical installations as they are installed in the airplane.

29 Two (2) Continuity Check Circuit Diagrams.

NOTE: As the harnesses are assembled, they are functionally checked by the use of a continuity checker. The material furnished under this item portrays the circuitry for each continuity checker required.

30 Two (2) sets of photographs of continuity checkers.

NOTE: This item will cover photographs of continuity checkers required.

31 One (1) reproducible Circuit Diagram Manual.

NOTE: The material furnished under this item will consist of a complete breakdown of airplane circuits to aid in the running of operations in final assembly or flight operations.

32 One (1) set of Glass Cloth Reproductions of Master Layouts.

NOTE: This item consists of glass cloth positive reproductions of Master Template Layouts.

33 First Ship Master Plan

NOTE: This [illegible] first ship schedule showing major component layout spreads

34 One (1) set of available breakdown of hours scheduled by department.

NOTE: This material consists of F-86F hours-performance by department of Ships #1 and #100.

35 Installation prints as used by Planning Department.

NOTE: Engineering installation drawings showing the correlation of "X" number Planning Orders. "X" number Planning Orders pertain to the correct installation sequences.

C. INSPECTION DATA

1 Two (2) Quality Control Policy Manuals.

NOTE: Quality Control Policy Manuals outline North American quality control policy.

2 Twelve (12) copies each of all applicable Inspection Operating Procedures.

NOTE: These are actual departmental procedures describing inspection operations and requirements.

3 One (1) copy of all Material Review Disposition Reports for the F-86E and F airplanes.

NOTE: These consist of reports of product discrepancies and action and disposition of each case.

4 Two (2) copies of all Production Development Laboratory Reports common to F-86E and F-86F.

NOTE: The reports are a summary of F-86E and F-86F production development problems.

5 One (1) copy of the North American Production Development Laboratory Process Control Manual.

NOTE: This item outlines the procedure for control of processes.

6 Two (2) copies of applicable Radiographic Inspection Standards for Aluminum and Magnesium alloy castings (as used by North American for Inspection Standards).

NOTE: Self-explanatory.

7 Two (2) copies of Production Development Laboratory testing procedures used for Receiving Inspection applicable to F-86E and F-86F airplanes.

NOTE: Self-explanatory.

D. PURCHASING DATA

1 One (1) print copy of Bill of Material.

NOTE: Bill of Material containing (1) list of all items of raw materials which indicates type of material, size and

description, specification and quantity; (2) list of fabricated parts (including standards and vendor-designed and Company Furnished Equipment) indicating part number, description, quantity, specification number (when applicable), weight and manufacturer's name and address on vendor-designed and Company Furnished Equipment only; (3) list of North American designed purchased parts including part number, description, quantity, and last known manufacturer's name and address; and (4) list of Government Furnished Property indicating part number, description, quantity and specification number (when applicable).

2 Two (2) print copies of Vendors Tool List.

NOTE: List of North American-owned tools in hands of vendors.

3 One (1) print copy of list of Estimated Cost of Purchased Raw Material, Equipment and Fabricated Parts.

NOTE: Self-explanatory.

E. MISCELLANEOUS DATA

1 Miscellaneous data pertaining to this License and Assistance Agreement not set forth elsewhere in this Exhibit A as requested by Mitsubishi in writing and approved by North American on a need-to-know basis as necessary information for the manufacture and assembly of the airplane.

SOURCE

Exhibit A to License and Assistance Agreement.

DOCUMENT CONTROL DATA

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10. ABSTRACT

A study of the problems of providing access to existing technology in order to overcome some of the barriers to price competition in the reprocurement of weapon system components, accessories, support equipment, and other specialized items. Entry of new firms into the production of technical hard goods is often hampered by three major barriers: (1) high-start-up costs; (2) the original developer's possession of patents or proprietary rights to technical information; (3) the Government's inability to provide new firms with technological rights and with data sufficient to support competitive production. Although the Government has generated some new policies on the collection and dissemination of data to potential suppliers, the percentage of reprocurements resulting from this dissemination is small and much essential information is not included in data packages. The aerospace industry has had vast experience in the transfer of production technology through the use of commercial licensing arrangements. The techniques used commercially could be adapted to reprocurement under a policy of directed licensing. The Government would derive several advantages from such a policy, including increased competition.

11. KEY WORDS

Aerospace industry
Military contracts
Prices
Procurement
Technology
Weapon systems
Research and development